

RECOVER YOUR LOST OR DELETED DATA!

apoc

March 2017
Issue 439

YOUR EXPERT

GUIDE TO TODAY'S TECH



MUST
READ

OUR MOST-THOROUGH GUIDE
EVER EXPLAINS HOW YOU
CAN GET BACK YOUR
ERASED FILES FROM PCS,
STORAGE CARDS AND MORE

100

TIPS & TRICKS FOR WINDOWS 10

DISCOVER HIDDEN TOOLS, MAKE
IT QUICKER & MORE CONVENIENT,
CUSTOMISE, TWEAK + HEAPS
MORE TIPS

CLOUD SECURITY CAMS

MONITOR YOUR HOME OR
OFFICE ANYWHERE &
ANY TIME WITH THESE
EASY-SETUP DIGITAL
SECURITY CAMERAS

PLUS

MINI-PC PROJECTS!

BRILLIANT CONCEPTS TO
HELP GET YOU THINKING
& BUILDING!

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& RATED

PINT-SIZED PCs

BIG POTENTIAL

MASSIVE MINI-PC COMPARISON! WE PIT 12 TINY CONTENDERS
IN A BATTLE FOR YOUR DESKTOP, LOUNGE ROOM & BEYOND



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MASTER YOUR PC & GADGETS

- SECURELY RUN WINDOWS APPS IN A SANDBOX
- PROTECT YOUR NETWORK WITH A RASPBERRY PI FIREWALL
 - DUAL BOOT LINUX
- MAKE A MAC MORE SECURE

HOW TO UNROOT YOUR ANDROID

SUFFERING FROM ROOT REGRET?
OUR STEP-BY-STEP GUIDE
SHOWS YOU HOW TO GET YOUR
PHONE OR TABLET BACK TO
ORIGINAL CONDITION

NEW PCs, PARTS & GEAR ON TEST

- \$850 INTEL MOTHERBOARD: IS IT BONKERS OR BRILLIANT?
- DELL'S NEW HYBRID XPS 13: THE PERFECT 2-IN-1?
- WE DON'T NEED NO CORE i3: PENTIUM RETURNS ON DESKTOP

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FIPP



Do you need security software?

APC's editor dives into the debate about whether Windows' built-in security is good enough to protect you.

In the nerdier parts of the internet of late, there's been a bit of an emerging brouhaha about whether third-party Windows security software is actually worth having installed. Ex-Firefox developer Robert O'Callahan's blog post (tinyurl.com/apc439-ocall) seems to have been the catalyst that kickstarted the wide conversation. O'Callahan explains that he's reached this conclusion after years of having to deal with problems caused by badly behaving security software, which (he says) interferes with other applications like Firefox... and for which those other apps often cop the blame.

O'Callahan reckons that, instead of a third-party security suite, you should just stick with Microsoft's built-in security back-end (aka Security Essentials or Windows Defender). But independent testing by the likes of AV-Test (from which APC sources its security scan results) seems to show that Microsoft's security apps aren't as effective at picking up malware as dedicated third-party programs – particularly when it comes to 'zero-day' threats that require heuristic scanning to identify.

Now, there's a lot of deliberately spread fear, uncertainty and doubt when it comes to digital security, and

we all know that we should be fairly wary when it comes to interacting with the online world – we need to practise 'defensive computing', says O'Callahan. That term covers things like:

- Keep your programs and OS updated with the latest versions/patches – in particular, your web browser and email client;
- Don't click on dodgy links or open/download files that could be risky – in emails or on the web; and
- Don't visit dangerous sites.

In practice, though, not everyone can be (or is interested in being) as tech savvy as your average APC reader. For many, it can be beyond their expertise – so for them, there's a good argument that running a third-party security suite is the lesser of two evils. But I won't be ditching my security software just yet. I've specifically chosen a suite that has minimal system impact... although that doesn't guarantee that it won't interfere in some weird way.



DAN GARDINER
EDITOR-IN-CHIEF
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ISSUE 439, MARCH 2017

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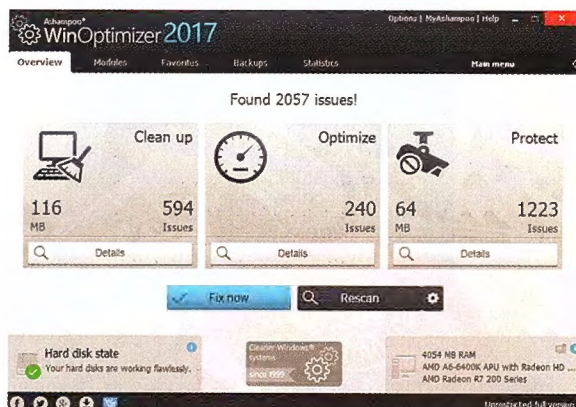
HELP YOUR PC RUN LIKE A DREAM

Stabilise your system with Ashampoo WinOptimizer 2017

FULL VERSION REQUIRES ONLINE REGISTRATION.

Ashampoo WinOptimizer 2017 stands for effective Windows optimisation, fixing errors and maintaining a smooth system performance. Various modules enable users to individually customise, analyse and optimise their Windows systems. Version 2017 includes the Win10 Privacy Control for added privacy protection on Windows 10 systems that disables unwanted telemetry and spy features. All cleaning modules have been updated and now support Microsoft Edge.

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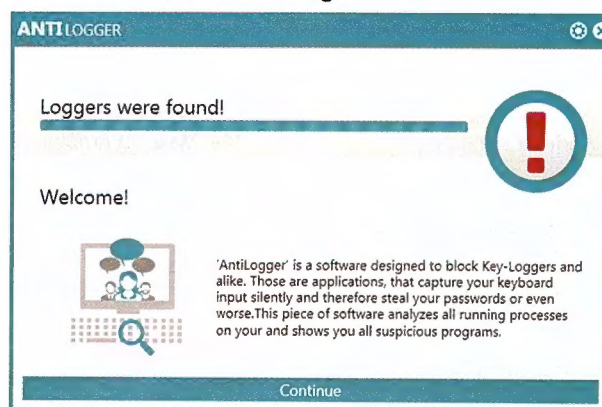
THWART MALICIOUS KEYLOGGERS

Fend off attempts to log and transmit your keystrokes with Abelssoft AntiLogger 16

FULL VERSION WORTH \$29.

Online crime is booming. And the favoured tools of cyber-criminals are perfectly effective enough to provide them with plenty of valuable user data. They can catch many users all too easily with so-called 'loggers' — all the victim needs to do is open the attachment of a spam email or visit an illegitimate website and, thus, the logger will be downloaded and begin embedding itself into the victim's computer. As the name implies, Abelssoft AntiLogger 2016 thwarts their attempts.

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» INSIDE APC

RECOVER YOUR LOST OR DELETED DATA!

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March 2017 Issue #350

THE MOST THOROUGH GUIDE EVER EXPLAINS HOW YOU CAN RECOVER LOST, DELETED FILES FROM PCs, STORAGE CARDS AND MORE

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- WE DON'T NEED NO CORE I3: PENTIUM RETURNS ON DESKTOP

EXPERT REVIEWED

the **apc** LATEST REVIEW

Dell XPS 13 2-in-1 (9365)

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FROM \$1,299 | WWW.DELL.COM/AU

apc RECOMMENDS

Gigabyte Aorus Z270X-Gaming 9

GamePad Digital XD

SteelSeries Rival 700

Corsair Carbide 270R

W

C

Inside APC

Find out all about APC's editorial policies, test practices, how to read the benchmark results and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, APC's journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, APC still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.



European Parliament debates giving robots human rights

**THE MACHINE,
THE ELECTRONIC MAN.**

A proposal has been approved by the Legal Affairs Committee of the European Parliament to control the future of robotics, which requires all robots to have kill switches for emergencies, have insurance (much like car insurance) and, if robots take on more human jobs, to pay taxes. It was also proposed that advance, sentient robots be given human-like status, or be considered "electronic persons". The proposal will now be reviewed by the European Commission. **SS**

Jury orders Facebook to pay US\$500 million in damages to ZeniMax

**AN EXPENSIVE REALITY
EXPERIENCE.**

At the end of a nightmarish court battle for Facebook, a jury awarded ZeniMax US\$500 million in damages for the violation of a non-disclosure agreement that Palmer Luckey, the co-founder of Oculus, had with the American media company. The jury also stated that Oculus had not misappropriated trade secrets as was contested by ZeniMax. The VR giant has said it will appeal the decision, but is also looking forward to putting the case behind it. **SS**

Snowden's email service of choice, Lavabit, has returned

THE FLOOR IS LAVA AGAIN!

On January 21, Lavabit relaunched their webmail service after having to suspend its operations mid-2013 due to a US investigation into Edward Snowden, one of the service's users. Lavabit offers a secure encrypted webmail service using the newly released "global standard" Dark Internet Mail Environment (DIME) and Magma, the mail server itself. **HD**

Windows 10



Windows 10 Cloud could be Microsoft's next big OS

Powered only by the Windows Store?

Not much is known about the new Windows operating system, but a recently leaked version of the Windows 10 Cloud was available online and first impressions are that the new OS isn't all that different from Windows 10. It seems to be a Windows 10 version of Windows RT that was released with the first generation of Microsoft Surface devices. This lightweight version of the OS possesses a lack of Win32 app support and possibilities are strong that it would be locked to the Windows Store, similar to Chrome OS which is designed to run only Google-approved apps. Recently leaked code revealed that Windows 10 Cloud would run only Universal Windows Platform (UWP) apps, and if that's the case, it could give Google's Chrome OS a run for its money.

Microsoft has refused to comment on the leak or the new OS, just saying, "We have nothing to share." But speculation is rife that the company could publicly launch Windows 10 Cloud during the release of the Windows 10 Creators Update later this year. **Sharmishta Sarkar**

Australian Federal Court rules on what aspects of metadata are deemed 'personal information'

ALL YOUR METAS ARE BELONG TO US.

A landmark ruling delivered recently by the Australian Federal Court has redefined 'personal information' or metadata collected by telcos under Australia's mandatory data retention policy. This information includes the location, timing, destination and duration of calls and texts, IP addresses, URLs visited and geolocation. According to the court, data is 'personal' if an individual is the actual subject of that information — meaning browsing history, IP address and location are not protected by Australian privacy laws as they relate to the communications services, not the person. This was the end of an ongoing battle between the Australian Privacy Commissioner and Telstra after journalist Ben Grubb asked the telco for his personal information. Thwarted by the telco's privacy department, Grubb took the complaint to the Commissioner who supported the journo. Telstra appealed to the Administrative Appeals Tribunal, where the telco emerged victorious. The Privacy Commissioner then took the matter to court, where his efforts in having everything that could be used to identify an individual be protected by the Privacy Act finally came to a halt. **Sharmishta Sarkar**



EU investigates Valve over anti-competitive region restrictions

TRUST NOT IN GAMING COMPANIES.

American gaming company Valve has become the target of an antitrust probe launched by the European Union. An agreement between game publishers and Valve is being investigated that allegedly blocks users from purchasing video games from Valve's Steam store based on where they live. The EU is concerned that how consumers purchase digital content is reducing cross-border trade and that game publishers may be using activation keys to block consumers, or limit access, to games based on geolocation. SS

Ransomware makes the leap to smart TVs

NOT SO SMART NOW, HUH?

Twitter user Darren Cauthon recently found himself with an malware-infected LG smart TV after his relatives apparently installed an unknown movie app. The ransomware, posing as an FBI penalty notice, asked for US\$500 to unlock the device, which was running the now discontinued Google TV platform. With LG's official support channels providing no assistance, it was only after pleading with the company via Twitter that Cauthon managed to obtain the instructions to factory-reset his TV and finally clear the infection. HD



Many Android VPNs don't do their job, according to security report

Your privacy may not be as private as you think.

According to a new paper funded by the CSIRO's Data61 research institute and the US National Science Foundation, many of the Android VPN apps found on the Google Play store have been found to leave user data exposed.

"Our results show that — in spite of the promises for privacy, security and anonymity given by the majority of VPN apps — millions of users may be unawarely subject to poor security guarantees and abusive practices inflicted by VPN apps," stated the researchers.

The study found that 82% of the apps requested permission to access accounts data and private text messages, 75% used third-party tracking libraries, 18% used tunneling protocols without encryption and 84% left IPv6 traffic unprotected due to lack of support, misconfigurations and developer errors.

Worse still, of the 283 apps tested overall, 38% were found to contain "some malware presence" when run through the free online virus scanner VirusTotal. These include the popular apps EasyVPN, TigerVPN and VPN Free.

Stephen Lambrechts

Printers hacked worldwide after critical flaw exposed

CHEEKY HACKER HAS FUN WITH SERIOUS EXPLOIT.

A hacker named Stackoverflowin has taken it upon himself to reveal how easy it is to access net-connected printers operating without a firewall. Using an automated script that he wrote himself, the hacker was able to scan for and identify devices with open ports, then send out rogue print jobs to the targeted printers.

Two versions of the printed message were reportedly sent out to, as the hacker claims, 160,000 machines from various brands — the first with ASCII art depicting a robot and the second with ASCII art showing a computer. Some warn the user that their device has been "pwned" and are now "part of a flaming botnet".

The message sent by Stackoverflowin also asks users to "close this port, skid". Users were left amused and confused, and many went online asking for advice on what to do. Stackoverflowin claims that this prank was done in good fun and that it was "about helping people fix their problem".

Sharmishta Sarkar

technotes

» HARRY DOMANSKI AND SHARMISHTA SARKAR LOOK AT THE NUMBERS DRIVING THE BIG TECH NEWS

350,000

THE SIZE OF A TWITTER BOTNET ARMY CURRENTLY LYING DORMANT.

The (potential) force is strong with this botnet. Two researchers in London have reportedly discovered the largest network of fake Twitter accounts comprising 350,000 bots that can be identified by their *Star Wars* tweets. The botnet was discovered when the researchers began sifting through Twitter accounts to see how the platform was being used, and analysis revealed that many of the fake accounts were linked, suggesting a single person, or a group, was controlling the botnet.



123 OF 187

THE NUMBER OF PUBLIC SPACE CCTV CAMERAS IN WASHINGTON DC THAT WERE INFECTED WITH RANSOMWARE.

Just one week before President Trump's inauguration was set to take place there in January, hackers attacked the District of Columbia's closed-circuit television (CCTV) surveillance system and managed to compromise 70% of police DVRs. The ransomware infected 123 of 187 network video recorders, each of which controlled up to four CCTVs, rendering them inoperable for 3 days between the 12th and 15th of January. The hack was discovered when police noticed four devices were not recording, forcing the city to wipe clean all the affected IT systems. Officials have confirmed that no ransom was paid.



62% less

THE PERCENTAGE DROP IN NEW OFFICE 365 SUBSCRIPTIONS THAT MICROSOFT EXPERIENCED IN 2016.

Microsoft recently announced that the subscriptions to the company's productivity suite had reached nearly 25 million. But according to the numbers crunched in the four years since the launch of Office 365, new subscribers were hard to find in 2016, having dropped by 62% in comparison with the previous year. Microsoft CEO Satya Nadella said that the Microsoft suite attracted only 4.3 million new subscribers in 2016 (compared to 11.4 million in 2015), but revenue from the consumer-related Office products had increased by 22%.



30 years

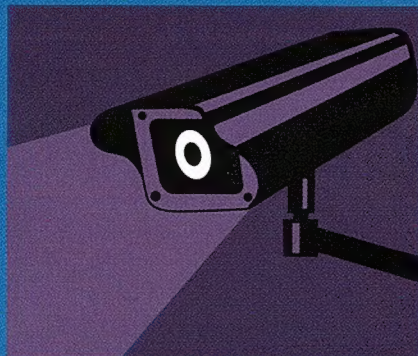
HOW LONG IT WILL TAKE BEFORE VIRTUAL AND AUGMENTED REALITY REACH MATURITY.

According to the VP of Qualcomm's Product Management, Tim Leland, we are "at the beginning of a 30-year cycle until we get the ultimate VR/AR device". Leland was quick to add that the short term for both realities still holds exciting developments, like high-tier devices going wireless, and the accessibility of mobile alternatives increasing, but he predicts that the end-goal is a single device that runs on a '5G' connection and can handle AR full-time, and VR when you want it.

¥700

HOW MUCH IT COSTS TO BUY A DETAILED DOSSIER ON ALMOST ANYONE IN CHINA.

If you live in China, your data is more than likely up for sale, thanks in part to "China's Great Firewall" — a term used to describe government legislation that regulates China's internet, often to the detriment of basic liberties. A number of private and state-owned enterprises use this as an avenue for surveillance, then offer up the collected data for sale. Canada's CBCNews found they could purchase data (with documented proof) on their colleague's bank records, flights, hotel records and more, for only 700 Yuan, or around \$130.



techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK



Blocking online content

In the interest of maintaining this glorious nation.

The censorship of information is a phenomenon undoubtedly as old as our species itself, and the suppression of information on the internet is an act carried out by most, if not all, countries in the world to varying degrees. While most democratic nations enforce blocking relating to copyrights (such as pirated, BBC or Netflix content) or obscene material (such as child porn), other nations habitually block foreign news sources and public forums to control its citizens' knowledge and discussions. While there are ways to circumvent blocked information – such as VPNs, DNS services and location-masking web surfing tools like Tor or Orbot – governments of certain nations and individual companies are attempting to crack down on such services to regain control over who can see what. In an age where the vast majority of people believe that access to the internet is a basic human right, there is a disturbing amount of censorship online, and with no signs of stopping.

Great Walls of Fire!

CHINA BANS UNAUTHORISED VPN SERVICES.

The Ministry of Industry and Information Technology in China recently announced that virtual private networks (VPNs) would hereby need to "obtain prior governmental approval" or be deemed illegal. VPNs provide invaluable access for many Chinese internet users to websites such as Google, *The New York Times*, Facebook, Twitter and YouTube, which lie beyond the country's Great Firewall of censorship. According to the announcement in late January, the Chinese internet service showed "signs of disordered development that requires urgent regulation and governance". It is unclear at time of writing just what an 'authorised' VPN service might look like...

NY Times app removed from Chinese iOS App Store

JUST ANOTHER BRICK IN THE FIREWALL.

Following on from the story to the left, Apple has recently removed the *New York Times* app from the Chinese version of the App Store for violating "local regulations" imposed by the Chinese Government. This is hardly news for the *NY Times*, as the country's government has been blocking its website since 2012 due to certain published articles relating to the then-head of state and his undisclosed wealth. Due to the fact that Apple heavily relies upon China as a huge potential market and also a manufacturing location, it's unsurprising that the company is bowing to the Government's regulation of the media.



Clash of Clans blocked in Iran

CARTOONISH GAME ABOUT WAR ACCUSED OF PROMOTING VIOLENCE.

The mobile strategy game *Clash of Clans* is rather popular in Iran (and everywhere else); however, a panel of Iranian psychologists has decided that the game encourages violence and tribal conflict. According to Iran's Deputy Attorney General, the "vast majority" of the panel (who, we're guessing haven't actually played *Clash*) voted to limit the availability of the title. While the ban may not be indefinite, the game can luckily still be played via VPN services. This is not the first game that has been blocked from players in the country, with *Pokémon GO* still banned due to the potential security threat wandering Trainers may pose to "sensitive locations".

LinkedIn banned in Russia

SERVICE DOESN'T COMPLY WITH COUNTRY'S DATA LEGISLATION.

In 2014, Russia passed a law requiring the online personal information of its citizens to be stored exclusively within the country's borders. US-based professional online network LinkedIn had been blocked via web access in November 2016, but now the iOS and Android versions of the app have been pulled from their respective stores, making access impossible. While many see this as the Government keeping tabs on its citizens, the parliament claims it's in response to allegations of US spying and security concerns.

technotes

» GEAR WE WANT

TOBII EYE TRACKER 4C

€159 | TOBII.GAMING.COM

We've previously been a little dubious about the usefulness of eye-tracking technology as a method for controlling games but, as they say, seeing really is believing, and after spending some time with an MSI laptop with Tobii's eye tracking technology built into it late last year, we've become more convinced this technology is no gimmick. Tobii support is integrated into over 45 AAA titles like *Watchdogs 2*, *The Division*, *Steep* and *Assassin's Creed Syndicate* and the Eye Tracker 4C bar monitors your eye-movements to let you control various in-game elements such as camera angle, HUD highlights, weapon targeting and even the ability to interact with the environment. **JB**



CUTU VPN

US\$99 PER YEAR | CUTU.IO

For most of us, a software-based virtual private network (VPN) is all that's needed to circumvent geoblocks and keep online activity under wraps. There are some notable hardware incompatibilities for software-based VPNs though, using games consoles that don't support native VPNs for example, which can leave you exposed. The Cutu device is a thin portable VPN router that'll allow you to channel hardware through a VPN. With three LAN ports, a WAN connection and two 2.4GHz 802.11/bgn WiFi bands, you can connect to this AC powered device using either a wired or wireless setup. Pairing with a VPN service that claims to hold no communication data logs, this 13.5cm hub offers a good all-in-one solution for shifting your IP address. **JB**



KWIKVR

\$TBA | KWIKVR.COM

If you have a full PC VR setup, there's a good chance you've already found yourself wishing you could ditch the cumbersome cables that attach the headset to the computer. And alas, the rumored wireless follow-ups to the Vive and Oculus headsets didn't show up at CES for the start of 2017, so it seems that native wireless VR headsets will have to wait a little longer. All's not lost when it comes to remedying this biggest obstacle in VR's suspension of disbelief, however. Aftermarket wireless VR headset dongle KwikVR is aiming to cut the cord with a 5GHz Wi-Fi based connection. On paper, the 4 hours play time, less than 12ms 'guaranteed' latency and universal compatibility sounds like a recipe for success. Whether or not KwikVR can achieve all this in the real world, however, is yet to be seen. **JB**



OHROMA

FROM US\$70 | WWW.CAMSODA.COM/LABS/OHROMA

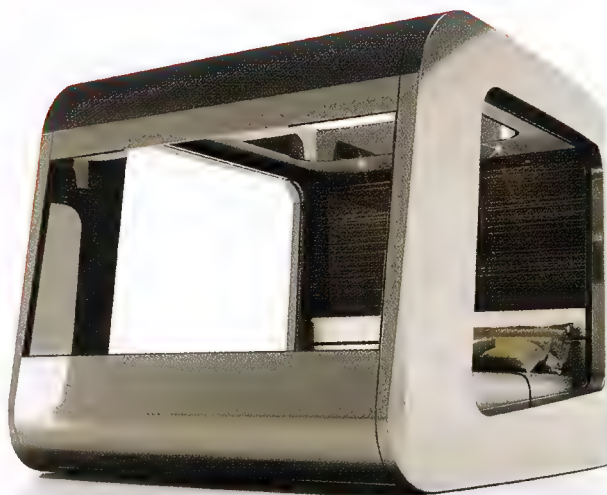


The internet was made for porn and virtual reality was... also made for porn. But there's something missing in the whole VR experience (apart from touch). Smell. Several weeks ago, CamSoda announced an upcoming gadget named the OhRoma – a “sensory mask” that users would wear in addition to their VR headset of choice. The device comprises two canisters with three interchangeable cartridge slots, which can be filled with all manner of mostly erotic smells; for instance, private parts, body odour, panties and aphrodisiacs, which can be purchased for US\$6–\$10 each. Attempting to provide a more “immersive experience”, the OhRoma is, let's face it, just another sex toy. However, if it could be harnessed for good, you could instead smell dirt and grass in *Minecraft VR*, blood in *Surgeon Simulator* and sweat or fear itself in *Keep Talking and Nobody Explodes*. **CS**

HICAN HIGH FIDELITY CANOPY

~US\$38,000 | HI-INTERIORS.COM

Now you can get your all-important beauty sleep in a revolutionary new smart bed. HiCan's “technological cocoon” is packed with features: configurable touch headboard, automated privacy blinds, dimmable lighting, a motorised footboard with home theater and multimedia capabilities – HD projector and projection screen, integrated surround sound system, Apple TV, and Xbox One or PS4. The height and angle of the mattress are also configurable using the compatible iOS (and Apple Watch) app. It surpassed its goal on Indiegogo by 125% at the end of 2016.



CANON ME20F-SH

US\$19,999 | USA.CANON.COM



Infrared cameras are useful while shooting in really dark conditions, but the resulting videos are usually more creepy than visually impressive. The Canon ME20F-SH is a high-ISO shooter that can capture crystal-clear images in near pitch-black conditions. Billed as the company's first ultra-high-sensitivity multi-purpose camera, the ME20F-SH uses a full-frame, 35mm CMOS sensor with massive photosites, enabling it to record quality HD video (little to no noise, accurate colours) in settings with illumination as low as 0.0005 lux – about the same level as an overcast night. **■**

tech notes

» HOW IT'S DONE

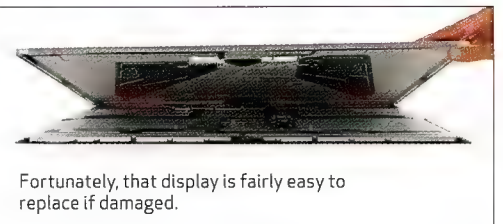


About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

Microsoft Surface Studio

Two PCs in one? Almost.



Fortunately, that display is fairly easy to replace if damaged.

The Surface Studio is big, expensive and powerful. But is this a machine for creative pros, or a me-too entry in the modern wave of fashionably disposable hardware?

MAJOR TECH SPECS

- 28-inch adjustable PixelSense display with 4,500 x 3,000 resolution (192dpi), supporting sRGB, DCI-P3, Vivid colour profiles, plus 10-point multitouch
- 6th-gen Intel Core i5 or i7 CPU, with 8GB, 16GB and 32GB RAM configuration options
- Nvidia GeForce GTX 965M GPU (paired with 2GB GDDR5), or GTX 980M (paired with 4GB GDDR5)
- 1TB and 2TB hybrid storage options
- 802.11ac Wi-Fi/Bluetooth 4.0/Xbox Wireless built in
- Surface Pen and Surface Dial

KEY FINDINGS

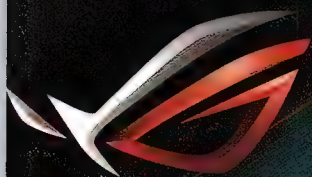
- We tip the Studio on to its back and inspect the base, hoping to find a way in. A strip of air vents borders the bottom panel, and at each corner, we

find a round rubber foot, concealing a Torx screw. The two on the front corners are of the extra-long variety. As manufacturers continue the fight against visible screws, we're OK with this solution — it's certainly better than gluing the entire thing shut. Screws jettisoned, the heavy bottom cover still holds on by way of several clips. So we apply a little suction power to yank it free.

- Pulling the back cover off reveals a myriad of components. There's a strict order of operations here. First out are two fans, but they remain anchored by wires with hidden leads. That midframe will have to come out before we can proceed further. As we lift it away, it brings an attached speaker out with it, along with a third wire tethered to the motherboard.
- Finally, we have access to some guts. We start with the high-powered half of the hybrid storage: a standard, removable, 64GB SanDisk Z400s M.2 SSD. On board, we find two SanDisk 05466 032G 32GB NAND flash storage modules, and a Silicon Motion

SM2246XT SATA 6Gbps DRAM-less SSD controller.

- It's time to return to that huge 28-inch glass display. Unsure what kind of adhesive lies in wait, we throw down a pair of iOpeners to soften it up. Many swipes of the iMac opening tool later, and we're ready to call this glue the in-between. It's not the overkill tar of the Surface Pro, but it's also not slice-it-down-the-middle clean iMac adhesive. It's in between. A bit of a struggle, but not impossible.
- **Repairability Score:** 5 out of 10 (10 is easiest to repair). The base is easy to open and home to several modular components that can be replaced without disassembling the display. The entire display assembly can be replaced as a piece, without dismantling the display or the base. The RAM, CPU and GPU are soldered to the board and cannot be upgraded. You may want to think twice about that 8GB configuration. A few components embedded in the display would be difficult to replace if they failed. ■



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GAMERS

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G-SYNC™

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World's Fastest Refresh Rate

240Hz native refresh rate on
a 24.5" Full HD display
best for fast-paced gaming

Ultra-smooth Graphics

1ms response time and
G-SYNC technology

Personalized Light Signature

Customizable lighting effects
on adjustable stand to create
unique projections

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technotes

» OPINIONS

unity

5

You too can design
spiffy moustached
chaps using Unity.

WEAR AND TEAR

I really enjoy reading your magazine and as a 72-year-old gamer, I love to keep up with your reviews on the latest technology and gaming gear.

My primary reason for writing is in relation to headphone/headset reviews. I have lost count of the number of perfectly good headsets I have had to scrap due to the unavailability of replacement ear protectors. This is an item that invariably wears out long before the need to replace the headset.

May I humbly suggest that some background regarding replacement parts be included in your reviews if possible, either from the supplier or third parties.

Jimmy Matchett

MORE UNITY PLEASE!

I managed to make three games and put them online at agentguy51.unity.io after reading your tutorial about making games in Unity. I was wondering why that tutorial hasn't expanded into many more parts? I would have really liked to have learnt more about Unity with maybe some C# scripting.

Emmanuel Harish Menon

Ed replies: The Unity guide was intended as a one-off, but we'd definitely

like to do more on game creation down the track. Stay tuned.

DITCHING WINDOWS FOR LINUX

In your December issue, you included some comments and instructions about Linux. I would like to share my humble experience.

For many reasons, I decided to dump Windows. Being not even remotely interested in Apple, the answer was Linux. I was impressed and over the moon that I found an alternative. I tried many distros and found that Linux is generally brilliant.

However, Linux is still behind in one area – video editing. There are many software options to do that. I tried many of them, if not all. The best is Avidemux, which still falls behind the software available in Windows. I thought it was only me, until I read a review on Linux magazine, where the Linux experts confessed to the superiority of Windows-based software in that regard. I record movies, documentaries and other programs and I like to cut out the ads. While Avidemux can handle the job, it's not particularly user-friendly.

Another piece of software that's not emulated well is Microsoft Office. Kingsoft WPS seems closer than LibreOffice to competing with Microsoft's suite, but it's still not quite

there yet. So can I drop Windows all together in favour of Linux? Not yet, unfortunately.

Dr Mohammad Hajarat

STORY SUGGESTIONS

I have a couple of requests for future articles. They may not fit under your usual editorial purview but I was wondering if you could look at:

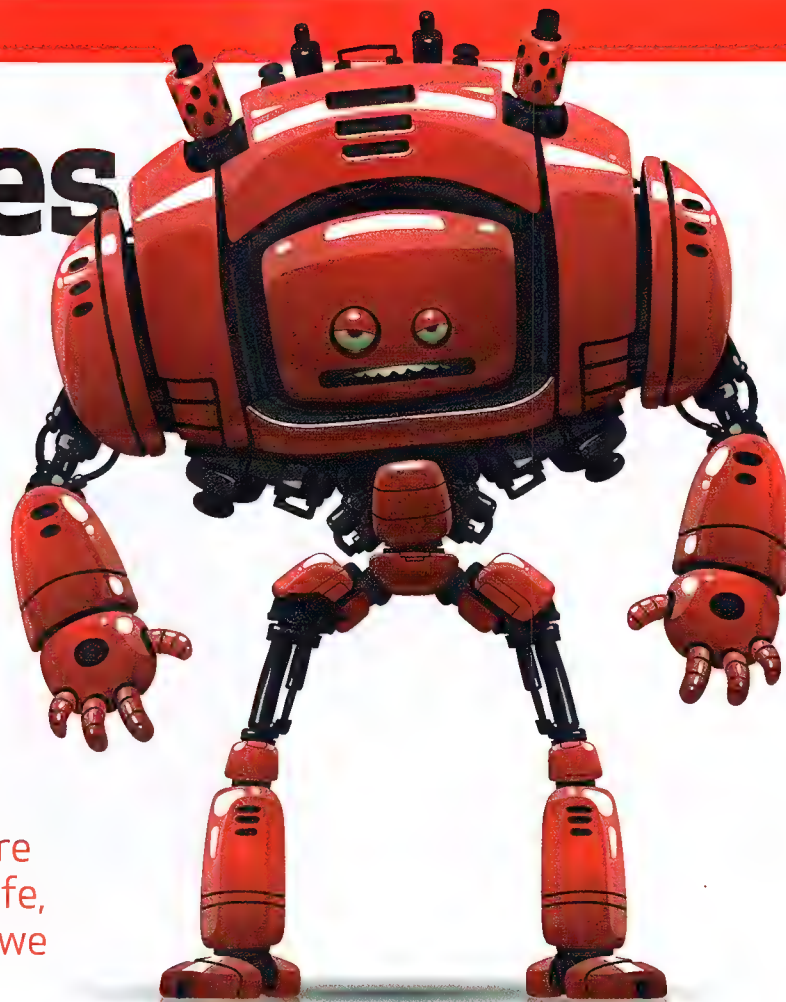
- Software containerisation, such as Docker. Seeing there are dockers for Raspberry Pi, it may fit your editorial policy and would be interesting – a guide to setting up a Docker image and deploy to have several running at the same time.
 - Cloud providers (AWS, Azure, Google and so on). Maybe do a comparison of where they're at regarding features and ease of use. Not sure how you'd justify what's more of a corporate IT technology – maybe just as a general interest thing. I'd be keen to read the opinions on their current state and where they're going by your experts.
- Stuart Boydell

Ed replies: Good suggestions, Stuart – containers is definitely something that's on our to-do list and we'll see if we can work a cloud-provider comparison in somewhere, too. ■

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.



Should we trust AI?

As the technology becomes more foregrounded in all aspects of life, Shaun Prescott asks: where do we draw the line?

Artificial intelligence, once only of pressing import to science-fiction fans and videogame enthusiasts, is increasingly dominating tech news headlines. It's been tipped as the answer to many modern conundrums, whether it be streamlined consumer services online or as a means to combat the dissemination of 'fake news'. But during a time when tech companies like Microsoft are investing heavily in AI, it's worth wondering whether it's a good idea to hand over so much power to systems. Indeed, is our world even prepared for the possibility that entire workforces could be wiped out by even more AI-led automation?

Even Microsoft founder Bill Gates is sceptical about AI, while Elon Musk seems vaguely scared of it. "I think we should be very careful about artificial intelligence," Musk said at a symposium in 2015. "If I were to guess at what our biggest existential threat is, it's probably that. So we need to be very careful with the artificial intelligence.

Increasingly scientists think there should be some regulatory oversight maybe at the national and international level, just to make sure that we don't do something very foolish. With artificial intelligence we are summoning the demon."

"Summoning the demon" is a far cry from "getting a computer to change your internet plan". Whether that's hyperbole or not, Gates, Musk and even Stephen Hawking are not alone among authority figures when it comes to fears regarding AI. According to Google researcher Chris Olah, speaking about a paper he contributed to on the subject, "It's essential to ground concerns in real machine-learning research, and to start developing practical approaches for engineering AI systems that operate safely and reliably."

These concerns range from preventing cleaner bots from causing electrical fires through to deeper concerns. As far as the latter goes, AI's effect on employment is of growing interest, especially on low-income and low-skill employment. The White House

released a report late last year entitled 'Preparing for the Future of Artificial Intelligence', which did not shirk from the question of whether jobs would be lost — indeed, it's very likely they will be, en masse. But it's not just low-skilled work that's on the chopping block: according to a report by Fortune, specialists have pointed to the likelihood that commercial airlines may one day be piloted by AI. That doesn't sound scary at all.

Still, it's hard to deny that AI's application to problems which are difficult to address by mere humans is worth advancing. Fake news, for instance, has proliferated to the extent that gatekeepers like Facebook cannot possibly police it with human moderation: can deep learning and algorithm-based vetting keep it from being distributed too widely and too dangerously? That indeed, is what many are positing as the answer. Better that than a computer operating heavy vehicles or driving your children to school. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

the

» LATEST REVIEW



2-IN-1

FROM \$2,299 | WWW.DELL.COM/AU

Dell XPS 13 2-in-1 (9365)

Spicing up a leading laptop all over again.

For the past few years, Dell's ever-evolving XPS 13 has been seen as one of the darlings of the laptop PC world. And the 2017 version looks to be no exception.

That's because, for this year's model, Dell has finally created a hybrid version of its leading laptop, and it's as versatile and as beautiful as you'd expect. It comes with the same 11-inch frame and 13.3-inch size screen as its predecessor, but the new 2-in-1 design brings a new wrinkle to the XPS range without totally disrupting it.

In other words, Dell will still keep making the traditional version, so don't worry, purists.

PRICED HIGHER

Dell is starting the XPS 13 2-in-1 at a slightly highish \$2,299, compared to \$1,899 for the regular laptop edition. The base 2-in-1 model comes packing an FHD (1,920 x 1,080) touchscreen with a 7th-

generation Intel Core i5 processor with Intel HD Graphics 615, 4GB of RAM and 128GB of solid-state storage.

From there, you can expect the usual upgrades you've seen from the XPS 13 over the past few years – an Intel Core i7 processor (still Kaby Lake), a QHD+ (3,200 x 1,800) touchscreen, up to 16GB of memory and as large as a 1TB SSD. The top spec model costs \$2,790 with various configurations in between to better suit different needs and budgets.

STILL SOLIDLY DESIGNED

Once famous for making sturdy but rather pedestrian-looking machines, Dell's sense of design has skyrocketed in recent years, and the XPS 13 2-in-1 is a delight to behold. While keeping the same-same general look and feel of existing XPS devices, this model adds two hinges made of steel and encased in machined

aluminium for additional durability.

The anodised aluminium lid and carbon fibre palm rest make a welcome return, all within the same 11-inch frame as the preceding model. In short, this is the XPS 13 you already know and love, but with some subtle, yet impactful changes.

The base model weighs in at just 1.24kg with higher spec models being slightly heavier. All models measure just 8mm at their thinnest point and 13.7mm at the thickest. All told, that's a shaving to the tune of 2mm, which is impressive considering the laptop's 2-in-1 trappings. The device is easily held in one hand, and its lightweight nature makes adjusting between its hybrid modes that much easier.

The XPS 13's palm rest feels as comfortable and responsive as ever, as do the glass-covered trackpad and backlit chicklet keyboard (with a satisfying 1.3mm of key travel) –

all carry-overs from the previous models.

However, one carry-over that we wish hadn't is the webcam, which is still positioned in the baffling location of below the display near the hinge.

While Dell has wised up and centred the infrared-equipped 720p HD webcam (hello, Windows Hello), it's still going to show off our double chin during meetings. At the very least, you can orient the device in a tent position so that the webcam faces upright.

The last major feature about the XPS 13 to make it into the 2-in-1 iteration is that beautiful, nearly bezel-free InfinityEdge display. The returning IGZO panel is notched at either 1080p Full HD or Quad HD+ resolutions – depending on which model you choose – but either way, brings plenty of brightness (400 nits), contrast (1,000:1 ratio) and viewing angles (up to 170 degrees).



SPECS AND PERFORMANCE

In addition to the handful of things you can change about the XPS 13 2-in-1 before you hand over your cash at the checkout, Dell has loaded the machine with plenty of other goodies.

In wired connectivity, you have two USB-C ports (one being Thunderbolt 3, but both can charge), a now-smaller microSD card reader and a 3.5mm headphone socket.

On the wireless front, the XPS 13 2-in-1 comes with the expected 802.11ac Wi-Fi and Bluetooth 4.2 with Miracast and Intel Smart Connect supported.

Now, all of this is powered by what Dell is calling upfront a 'lower-power' processor, though both Core i5 and i7 options can reach 3.2GHz and 3.6GHz clock speeds, respectively.

That said, Dell has devised a dynamic power management system focused on temperatures that should work extra well

"Once famous for making sturdy, but rather pedestrian-looking machines, Dell's sense of design has skyrocketed in recent years. And the XPS 13 2-in-1 is a delight to behold."

with a laptop cooler when you need that extra oomph.

That power management should also help keep the included 46Whr battery powering the whole system for a little longer. Dell promises up to 15 hours of juice from the Full HD version of the XPS 13 2-in-1, while the Quad HD+ flavour will enjoy a still-lengthy 8 hours and 35 minutes – based on its own tests. Your mileage will, of course, vary depending on your usage.

A GREAT 2-IN-1?

We may be barely a quarter of the way into 2017, but Dell has already crafted one of the most impressive laptops of the year. With the public perception of 2-in-1 laptops

far better than it was even just 12 months ago, it's picked a good time to bring those features to its leading laptop.

The XPS 13 2-in-1 sacrifices almost nothing in achieving its new design, save for a smaller microSD card reader and a standard barrel connector for power. That said, despite its massive improvements and centring (at last), we're still not exactly convinced about the webcam beneath the screen.

At the end of the day, we were thoroughly impressed by the now-hybrid XPS 13. Dell has managed to bring a new level of form and function to its most pleasing product for not much more cash

to start than the traditional version. We can't wait to see what it comes up with next.

■ Pablo Sanchez

Verdict

Features
Performance
Value



Dell's best ultraportable now gives you the option of running as a tablet too, but that'll cost you more than the original.



✓✓✓
apc
RECOMMENDS



LAPTOP

\$1,698 | WWW.ACER.COM

Acer Swift 7

It's the world's thinnest laptop, but can it stand up to its slightly thicker competitors where it counts?

Taiwanese PC-maker Acer revealed a couple of rather attractive portable sister PCs at the end of last year – a laptop and a 2-in-1. We looked at the latter – the Spin 7 – in our January issue (see page 34) and this Swift is basically cut from the same cloth – albeit to a much slimmer form. This is officially the world's thinnest laptop, squeezing in at just 9.98mm thick and weighing 1.12kg. But is the attraction just physical?

There's a Core i7 chip powering the show, combined with a 13.3-inch LED-backlit 1080p display, 256GB SSD and 8GB of memory. And despite those satisfying specs, it comes in at just \$1,700 – a lower-than-average price for a premium ultrabook, which in Australia has crept up to around the \$2,000 mark. Also gratifying is that all the internal hardware is passively cooled, so there are no fans and it operates completely silently.

While the trackpad is almost comically wide, it's pleasingly sharp and responsive, and the chiclet keyboard performs well, although it isn't backlit – the body is presumably too thin to fit the mechanism as well as an LED.

As with all these super-slim laptops, the ports they can fit in are limited, however. Here, that means you get just two USB 3.1 Type-C sockets at the back of the right edge – one of which doubles as the charging port – plus a 3.5mm headset I/O. Acer has thrown a small dongle in the box that'll adapt one of those Type-C ports to the more traditional Type-A, so you can whip that out when needed.

On the surface then, that all sounds like a laptop that makes few compromises, but there has been at least a little bit of sacrifice of function to accommodate form. This isn't as good as Dell's XPS 13 in terms of battery life or horsepower,

for example – although in fairness, the Dell is twice as thick and an extra 160g or so heavier. And while the Swift doesn't match the XPS's class-leading battery life of up to 7 hours, it still manages an acceptable 4–5 hours in the same mixed-task home/office workloads, and is a bit under 6 hours for watching 1080p movies.

Something we've pointed out before, but that's worth reiterating, is that Intel's rebranded its low-power 'Core M' chips with this seventh-generation Core (aka Kaby Lake) chips. That means that, despite the name, the Core i7 used here isn't really the same as what you'll find in, say, ASUS's ZenBook 3 or the Dell XPS 13 – the giveaway is the 'Y' in its model identifier (i7-7Y75), meaning it's frugal in terms of power use, but it also runs at a lower clock speed and can't reach the same performance levels as its 'standard' mobile Core i7 counterparts. How much of an impact that

actually makes will depend on your computing needs.

The Swift mainly falls over when it comes to tasks like video encoding, high-res multimedia work and heavy multitasking. That said, if you're just surfing the web, working with documents and watching videos or doing a little light gaming, then the Swift holds up proficiently.

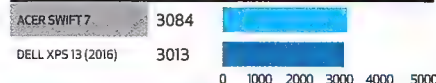
So while this isn't an ultrabook for everyone, for most it should suit perfectly fine. Definitely one worth considering if you're looking for an uber-thin laptop that still delivers the goods.

■ Dan Gardiner

LABS BENCHMARK RESULTS

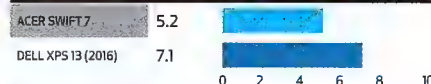
General system performance

PCMARK 8 - HOME (SCORE)



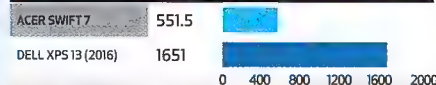
Video encoding performance

HWBOT X265 - 1080P (AVG FPS)



Disk performance

CRYSTAL DISKMARK 5 - SEQUENTIAL READ (AVG MB/S)

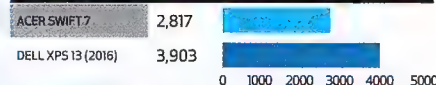


CRYSTAL DISKMARK 5 - SEQUENTIAL WRITE (AVG MB/S)



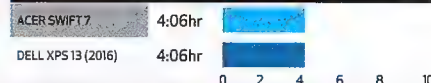
Gaming performance

3DMARK - SKY DIVER (SCORE)

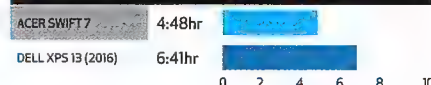


Battery life

PCMARK 8 - HOME (HRS:MIN)



PCMARK 8 - WORK (HRS:MIN)



Verdict

Features
Performance
Value



It's not without a little compromise, but delivers a good mix of usability and form that'll suit less-demanding users.



msi



BEST MEETS BEST REACH NEW HEIGHTS



GE72VR / GE62VR Apache Pro



GEARED WITH LATEST
7th GEN. INTEL® CORE™ i7 PROCESSOR &
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7th GEN. INTEL® CORE™ i7 PROCESSOR	WINDOWS 10 HOME / WINDOWS 10 PRO	
GEFORCE® GTX 1070 / 1060 / 1050 Ti GRAPHICS	VR READY	NAHIMIC VR
AL ALLOY CHASSIS DESIGN	120HZ / 5MS GAMING DISPLAY (optional)	
COOLER BOOST 4	DYNAUDIO	FULL COLOR BACKLIT STEELSERIES KEYBOARD
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Wireless 1	(02) 9687 8828	http://www.wireless1.com.au
Mwave	1300 727 446	http://www.mwave.com.au
Kong Computer	1300 159 272	http://www.kongcomputers.com
JW Computers	(02) 9726 2818	http://www.jw.com.au
Dcomp Online	(02) 4721 3457	http://www.dcompsonline.com.au
Shopping Express	(02) 8338 8899	http://www.shoppingexpress.com.au
Digital Star	(02) 8748 6888	http://www.digitalstar.com.au
PC Byte	(02) 9723 0306	http://pcbyte.com.au

QLD

Umart	(07) 3369 3928	http://www.umat.com.au
Computer Function	(07) 3720 4777	http://www.computerfunction.com.au
Computer Alliance	(07) 3421 3200	http://www.computeralliance.com.au
GameDude Computers	(07) 3387 1590	http://www.gamedude.com

VIC

Tesc	(03) 9682 3499	http://www.tesc.com.au
Scorplec Computers	(03) 9249 6000	http://www.scorplec.com.au
PC Case Gear	(03) 9560 2122	http://www.pcscasegear.com
PLE Computers	(08) 9309 4771	http://www.ple.com.au
Centrecom	(03) 8311 7600	http://www.centrecom.com.au
BCC Computers	(03) 5227 6888	http://www.bcccomputers.com.au/geelongwest
CPL	(03) 9223 4288	http://www.cplonline.com.au
Prototech	(03) 5444 1980	http://www.prototech.com.au
Umart	(07) 3369 3928	http://www.umat.com.au

SA

Getright Computers	(08) 8231 0622	http://www.getright.com.au
IT Warehouse	(08) 8296 3211	http://www.itwarehouse.com.au
ALLNEEDS	(08) 8211 8661	http://www.allneeds.com.au

NEW ZEALAND

JUSTLAPTOPS	(09) 442 2066	http://www.justlaptops.co.nz
Computer Lounge	(09) 368 4818	http://www.computerlounge.co.nz
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COOL INNOVATION



GAMING LAPTOP

\$1,999 | AU.MSI.COM

MSI GE62 7RD Apache

A gaming laptop that's part revered native-American warrior, part shabby French ruffian.

Finding gaming laptops close to the \$2,000 mark has historically been a difficult exercise, and a decent one at that has been nigh impossible. So when you consider that MSI's GE62 7RD Apache has both a latest generation Intel CPU and a new Nvidia Pascal GPU, it's hard to understand how it's managed to come in at a retail price of just \$1,999.

There's definitely been some penny pinching when it comes to the form and exterior materials. This laptop returns to a black brushed-metal veneer finish. Weighing in at 2.5kg, this isn't a particularly lightweight unit, nor is it particularly compact, sporting a thick chassis that accommodates an optical drive and a set of ventral, posterior and anterior vents that service two 50mm fans, which are mercifully big enough to keep the device cool without being too loud.

Despite our ragging on the budget-oriented exteriors,

we're happy that the quality of the internal components has been made the priority. At the heart of the GE62 is a premium seventh-gen Intel Core i7-7700HQ CPU, backed up by 16GB of DDR4 RAM, an obscenely-fast 128GB PCIe SSD and a crisp 1080p anti-glare IPS display.

This is the first laptop we've tested that has an Nvidia GeForce GTX 1050 GPU (4GB) in it. Historically, the GTX x50 series of GPUs have been aimed at gamers playing less graphically intensive online titles, where responsiveness is key; however, with this new 10-series, the considerable boost in GPU grunt makes the GTX 1050 competitive with more demanding games, too.

This rig manages to pump through PCMark 8's Work and Home CPU-heavy tasks with respective scores of 3,913 and 5,173 – faster than any other laptop we've tested to date... although, with an Intel seventh-gen CPU, that's not surprising. That GPU is no slouch either,

grinding out scores of 2,611 in demanding graphical benchmarks like 3DMark's Fire Strike Extreme, putting it ahead of last generation's tier-above GTX 960M. This comparative boost is consistent across newer titles like *Batman: Arkham Knight* and *Far Cry Primal*, too, with this MSI pulling average frame rates of 48fps and 28fps, respectively, while the older Dell unit only managed 35fps and 22fps. When pitted against MSI's GS43VR 6RE (as seen in APC 437 page 33), which was tested with a sixth-gen CPU and a GTX 1060 2GB GPU, the relative graphical performance fluctuated a little, with similar scores of 30fps in *Far Cry Primal* on 1080p Ultra settings, but significantly faster 71fps frame rate averages in *Arkham Knight* using 1080p High graphical settings. There is still a significant gap between this 1050 and the 1060, then.

For a sub \$2,000 laptop, though, the GE62 7RD performs at a level we

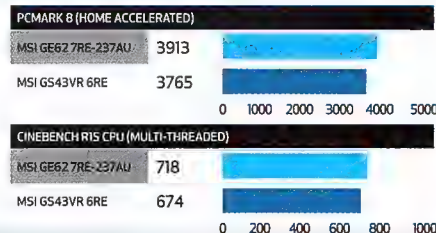
haven't seen before and is a great performer for anyone seeking a gaming setup on a budget. It's worth noting that this performance still comes at the cost of battery life, which won't even get you through an hour of general web browsing and movie watching when in performance mode.

It'd be remiss of us if we didn't point out that, by spending another \$500 or so, you'll not only get higher-end components that perform better, but also more compact and nicer looking gaming laptop, like Gigabyte's Aero 14 (see APC 437, page 32).

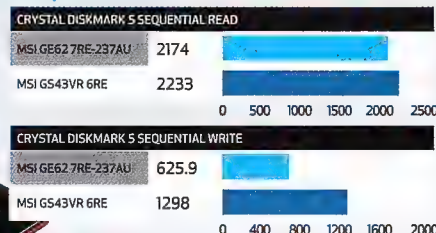
Joel Burgess

LABS BENCHMARK RESULTS

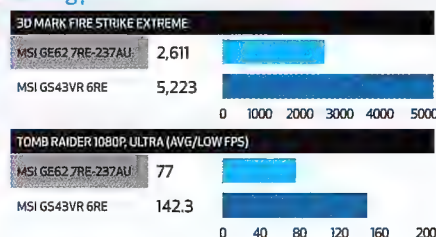
General system performance



Disk performance



Gaming performance



Verdict

Features
Performance
Value



A well-performing gaming laptop at the right price, if you don't mind the chassis looking a little cheap.



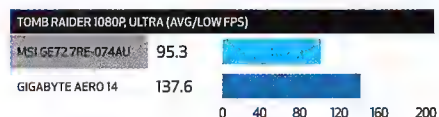
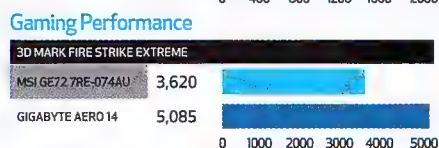
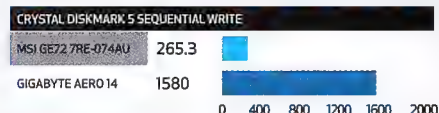
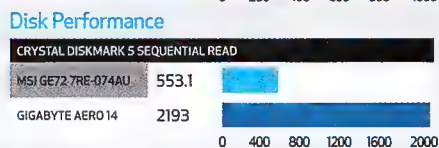
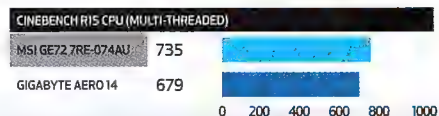
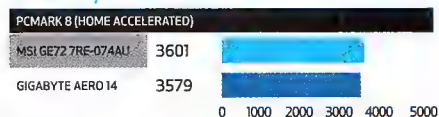


GAMING LAPTOP

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LABS BENCHMARK RESULTS

General System Performance



MSI GE72 7RE-074AU Apache Pro

You know what they say about laptops with big screens...

The cumbersome nature of 17-inch gaming laptops has always elicited a somewhat ambivalent response from us here at APC, and although we're impressed by the MSI GE72 7RE's better-than-average 2.7kg weight, this unit still suffers from the same bulky physique as most of its brethren.

The GE72 7RE has an identical streaky black-metal finish as its smaller sibling the GE62 7RE (opposite). It also seems to share the same fans and vent layout, which does a similar job of keeping the GPU cool, but could perhaps manage the Core i7 CPU's uncomfortably-hot 96°C peaks better.

Don't be fooled by these similarities, though. A new seventh-gen Intel Core i7-7700HQ CPU – reported to be 8% faster than last year's top-of-the-line laptop CPU – sits at the centre of the GE72. The new 2.8–3.8GHz chip isn't the only debut packed into this unit;

this is the first laptop we've tested with an Nvidia GeForce GTX 1050 Ti. Add to this a 16GB stack of DDR4 RAM, a 128GB SATA 6Gbps SSD and a 1TB Hitachi HDD and you've got a well-rounded gaming laptop.

A Core i7-7700HQ CPU and 16GB of RAM is a combo that's naturally going to execute binary tasks expediently and since we've only tested one laptop CPU that outpaced the GE72 (the Intel Core i7-6920HQ from MSI's \$7,000 GT83VR), this laptop clearly stands up to expectations. Nailing a multithreaded CPU score of 735 and a single-core score of 144 in Cinebench R15's CPU benchmarks, compared to the i7-6700HQ wielding MSI GS43 6RE's respective scores of 674 and 123, supports the claim that these chips are 8% faster than their predecessors. Although there is the option for a PCIe SSD, the 128GB Toshiba SSD on the unit we tested uses the notably slower SATA 6Gbps interface and so only

hit sequential (Q32T1) read and write speeds of 553MB/s and 265MB/s.

When comparing the overall framerates churned out by this laptop's 4GB GTX 1050 Ti to other laptop GPUs, its performance was closer to the scores of a 1060 (with 2GB VRAM) than it was to the GE62's 4GB 1050 on many of the game titles we tested.

The longer-term applicability of these real-world scores should probably not be taken for granted, however, since you see a big distinction in results from 3DMark's Fire Strike Extreme benchmark that pegs the GE62 7RE (GTX 1050) at the bottom with 2,611, with the GE72 7RE (GTX 1050 Ti) hitting the board in the middle with a score of 3,620 and Gigabyte's Aero 14 (GTX 1060) shaming both of them with a lofty 5,223.

We wouldn't recommend counting on this unit to last very long while not plugged in since the 51Wh Lithium-ion battery only manages to

stretch to 2 hours and 6 minutes in PCMark 8's Home Accelerated battery life test, with the computer in a balanced power profile.

The low 5ms-latency 1080p screen is definitely one of the highlights of the GE72 7RE, so we're willing to curb our criticism of the device's overall size, since it's inexorably part of a package that many will want. At \$2,199, you're getting an excellent raft of often high-end components that won't disappoint, and there are enough additional upgrades over the similar GE62 7RE to justify the extra 10% outlay.

■ Joel Burgess

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

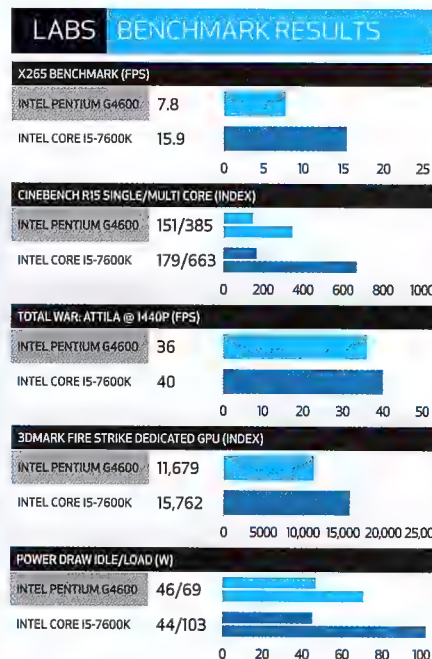
With near VR-ready performance and plenty of screen real estate, just don't expect it to be pleasant to lug around.





INTEL CPU

\$125 | WWW.INTEL.COM.AU



Intel Pentium G4600

Hip, hip, hooray for Hyper-Threading.

It's very likely the end of days for Intel's CPU strategy as we know it, but not in an apocalyptic sense. But AMD's Ryzen processor is coming and we're confident it's going to shake things up.

That's the context into which Intel's Pentium G4600 arrives. Based on the latest Kaby Lake microarchitecture, it's very much a child of the last five years or so, when Intel ruled the high seas, across the land, and in the air. Within that narrative, the fact that Intel has bequeathed the G4600, plus two other new Kaby Lake Pentiums, with Hyper-Threading capability constitutes news.

Hyper-Threading is the ability for each CPU core to process two software threads in parallel. And it's been baked into every Intel Core processor since Nehalem in 2008. Actually, it's rumoured that it was also in the Core 2 Duo, just not enabled. And, of course, it was first seen in the

Pentium 4 Netburst chip way, way back in 2000.

The point is that it's always in any desktop CPU model you buy from Intel; it's just enabled or disabled to help cook up a few different chip models. It's the sort of ruse you can get away with when you have little to no competition – a situation that prevails today, but isn't going to last.

Anyway, the Pentium G4600 slots in at \$125, and offers up two Hyper-Threading enabled 3.6GHz cores, supported by 3MB of cache memory. And that's pretty much it for the CPU side of things. There's no turbo mode, and the CPU multiplier is locked, so overclocking is essentially a non-starter.

Like all mainstream desktop CPUs, the processor cores are only half the story, literally, as integrated graphics make up almost half of the G4600's 14nm CPU die. In this case, it's an Intel HD Graphics 630 GPU, at the top end of the smaller of the two graphics cores

Intel is sticking in its Kaby Lake chips. It has 24 execution units to the 48 of the Iris Plus cores. So, even by integrated standards, it's nothing special. But for \$125, you aren't getting special.

What you are getting is very good single-threaded performance. The G4600 cranks out 151 points in Cinebench R15 in single-threaded mode. The Core i7-7700K manages 182. Put another way, if all you were interested in was single-threaded performance, and overclocking wasn't in your vocabulary, there'd be little reason to spend more than 125 bucks on a G4600.

Flick the multi-threading switch, on the other hand, and those numbers jump to 385 and 970. The 7700K is only a quad-core chip, of course. The 10-core Core i7-6950X monster will spew out about 1,750 points in Cinebench. Then again, it costs about 15 times as much. Arguably, then, what matters is that for general-purpose computing, the

G4600 gets the job done. It feels perfectly zippy for web browsing, playing back HD video content, and most anything else you're likely to do day to day.

It even turns in decent numbers in games, showing that the age-old problem of coding games to scale beyond a few cores remains. Just don't try to use it to re-encode hours of 4K video or render a pro-level 3D scene. In the current reality, then, the G4600 is appealing. But change is in the air, and the measure by which CPU value is assessed could be very different within just a few weeks.

Jeremy Laird

Verdict

Features
Performance
Value



Excellent single-threaded performance; very cheap for an Intel Core-based chip; it's got Hyper-Threading!



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MOTHERBOARD

\$849 | WWW.GIGABYTE.COM.AU

Gigabyte Aorus Z270X-Gaming 9

Gigabyte turns the Aorus range up to 11.

The Z270X-Gaming 9 is expensive. However, the mindset behind a product like this is that 'price doesn't matter'. It's what's known, in industry parlance, as a 'halo product' – one meant to capture attention, inspire technical potential and explore boundaries. While it's rare in the motherboard market, plenty of other companies use this kind of strategy.

This is a bit of kit for enthusiasts – it should be approached with an open mind when assessing its features and innovations, especially given many of the reasons for the inflated price are fairly opaque 'under the hood' ones.

For example, the audio implementation (Creative Sound Blaster certified ZxRi 120+dB+ Audio) brings together a combination of components to create a genuinely delightful audio

experience; including the Creative CA0132 Core3Di quad-core audio processor, BurrBrown PCM1794 stereo DAC, Cirrus Logic CN8416 ADC, two new Japanese Radio Co JRC2114D amps, a Texas Instruments OPA2134 amp and a Texas Instruments TPS5130 for powering the amplifiers.

The APC team has a long-standing preference for Intel networking devices, whether wired or wireless, and to see the Intel i219-V (also featured on the Aorus Z270X-Gaming 5 and 7, see issue 437) dropped in favour of Killer-branded NICs did cause us some concern.

The Gaming 9 has not just one but two Killer E2500 1Gbps NICs, alongside an 802.11ac Wi-Fi NIC, the Killer Wireless-AC 1535. This trio of Killer NICs provides hardware support for Killer DoubleShot-X3 Pro, a software feature providing a three-way network-teaming tech that

combines bandwidth and spreads the load across the three network connections. This is a neat feature for those craving network bandwidth, though you will require a hefty network connection to fully utilise the bandwidth capability.

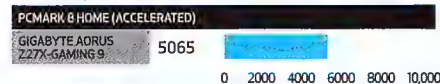
The implementation of a PLX chip provides a PCIe bridging hub for the platform and delivers 3- and 4-Way SLI and CrossFire support – Z270 otherwise only provides 2-Way SLI support. This is a neat feature and a significant point of differentiation; however, these types of setups are notorious for introducing processing latency. This was evident in the performance results in *Far Cry Primal*. The symptoms also appeared in the 3DMark graphics and combined tests; however, notably, the CPU and memory performance is significant on this motherboard with an

outright first place in the physics test compared to the Z270's we compared in APC 437. Those high CPU and memory performance results appear again in the PCMark 8 and X265 4K video-encoding tests.

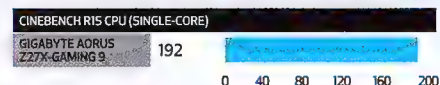
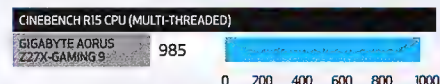
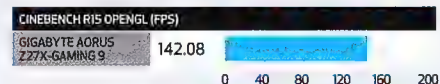
We hope to see Gigabyte continue its challenge to ASUS within the halo and premium product categories, as this can only bode well for consumers as innovative tech filters down the product stack in future models, as previously high-end features become the norm. ■ Josh Collins

LABS BENCHMARK RESULTS

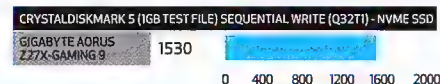
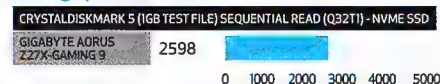
General performance



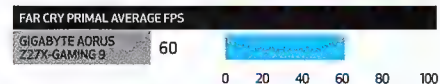
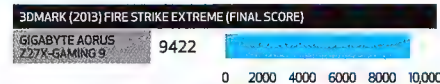
Multimedia & encoding performance



Storage performance



Gaming performance



Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A cool piece of engineering, packed to the rafters with features. If the price concerns you, this one isn't for you.





INTEL Z270 MOTHERBOARD

\$290 | AU.MSI.COM

MSI Z270i Gaming Pro Carbon AC

Z270 ITX offering.

In the early noughties, an interesting concept arose from our fervent pursuit of more powerful technology: as transistor size shrank, efficiency per watt increased, and die size fell, manufacturers aggressively pushed for smaller and smaller devices. The ITX form factor was developed in 2001 by VIA Technologies as a way of shrinking desktop computers to a more manageable size, and it has since become a staple for enthusiasts looking to build a tiny desk-sitting powerhouse.

MSI's Z270i Gaming Pro Carbon is the first in the latest line of Kaby Lake boards we've seen that deals with ITX. And we'll be honest: although the on-board support is as good as, if not better than, it has ever been, the rear I/O gives us pause. This isn't limited to MSI, though – Gigabyte,

Asus, and ASRock have all stripped down the rear I/O of their ITX offerings and put about 25 percent less stuff on it. Because, you know, ITX system users have fewer peripherals, or something. Yeah, we don't get that logic either. Anyway, let's compare the Z97i Gaming AC against the Z170i Gaming Pro and the Z270i Gaming Pro Carbon. The Z97i has four USB 3.0 and four USB 2.0 connections, giving a total of eight. The Z170i has four USB 3.1 and two USB 2.0, for a total of six. And the Z270i has three USB 3.1 and two USB 2.0 – a total of just five. It sounds like a petty complaint, but look at the plethora of peripherals that connect via USB, and it's easy to see how quickly those connections can be taken up. A mouse, a dual-port keyboard with a pass-through, a webcam, a USB headset – that's five ports taken up immediately.

Got a wireless dongle? Too bad. A wireless controller? Not any more.

PIN POINTS

USB woes aside, MSI's Z270i Gaming Pro Carbon is a solid board. It's nice to see the ITX layout get finalised, with 24-pin and 8-pin power getting concrete placement, and SATA and USB being more accessible than before. The reinforced DDR and PCIe ports, although laughable, do give you a little more assurance – the weight of a GPU isn't going to shatter them. And the M.2 PCIe x4 slot on the back keeps us happy when it comes to super-fast storage.

Performance was consistent, as always, with little variance between many of the benchmarks. Memory latency took a hit, and our X265 benchmark was the worst of the boards we've tested so far, but that was made up for by the lower power draws.

Overclocking was a little under par – our lowest undervolt from stock was 1.1V, the highest of the boards we've tested, and we managed 5GHz at 1.32V, compared to the 1.3V of last issue's more overclocking-oriented XPower Titanium. It is a solid offering – it's just a shame that the rear I/O is shrinking at such a rate.

■ Zak Storey

LABS BENCHMARK RESULTS

X265 BENCHMARK (FPS)

MSI Z270i GAMING PRO CARBON	20.57	
MSI Z270 XPOWER GAMING TITANIUM	21.15	

FAR CRY PRIMAL @ 4K (AVG FPS)

MSI Z270i GAMING PRO CARBON	43	
MSI Z270 XPOWER GAMING TITANIUM	42	

3DMARK FIRE STRIKE EXTREME (INDEX)

MSI Z270i GAMING PRO CARBON	9,508	
MSI Z270 XPOWER GAMING TITANIUM	9,595	

MAXIMUM OVERCLOCK ACHIEVED (GHZ)

MSI Z270i GAMING PRO CARBON	5	
MSI Z270 XPOWER GAMING TITANIUM	5	

POWER DRAW IDLE/PEAK (W)

MSI Z270i GAMING PRO CARBON	41/117	
MSI Z270 XPOWER GAMING TITANIUM	45/131	

Verdict

Features	★★★★★
Performance	★★★★★
Value	★★★★★

Solid performance; well laid-out; M.2 port on rear.





SATA SSD

\$830 | WWW.CRUCIAL.COM

Crucial MX300 2TB

The cheapest 2TB SSD in town.

Solid-state storage is one of the wonders of the modern world, reminding us of the immortal words of Arthur C Clarke — any sufficiently advanced technology seems like magic.

Go back 100 years, and what would anyone make of, for instance, a 256GB microSD card? The notion something so tiny could store hundreds of thousands of books would surely seem like witchcraft. Nowadays, it's pretty impressive that you can bag a 128GB USB stick for under \$100.

Despite that, SSDs aren't yet the default option for mass storage. That will happen eventually. But not yet, not even thanks to Crucial's 2TB MX300. It's about as close as you'll get to a really big SSD aimed at a mainstream audience. At \$830, however, it's getting on for nine times the price of the cheapest 2TB mechanical hard drive.

Of course, the MX300 still majors on capacity rather than performance. That's

because it's a SATA drive, rather than a PCI Express model, which brings limitations in terms of the peak bandwidth on the SATA interface and the inefficiencies of the AHCI protocol it uses. The latter never being designed with solid-state storage in mind.

We're talking peak claimed performance around 500MB/s for reads and writes, and IOPs a fair bit below 100,000. The 2TB MX300 has the same claimed performance for sequential throughput and IOPs as the 1TB, 750GB, and 525GB MX300 models. Only the 275GB model differs with lower performance. It also shares the familiar Marvell 88SS1074 controller with the rest of the MX300 family.

Similarly, this 2TB model uses the same 384GB TLC 3D flash memory dies as previous MX300s. It's that unusual capacity per die that leads to the MX300 range having odd sizes, with this drive serving up

2,050GB. The MX300 range also has a dynamic write acceleration mode that switches a portion of the memory to SLC mode for increased performance. For the 2TB model, the amount of memory that can be switched to SLC mode is increased.

The MX300 also comes with Crucial's SSD management software, which enables you to tweak settings and performance. Among other features, you can update the firmware, monitor the health of the NAND chips, and toggle the Momentum Cache feature, which uses system memory to buffer random writes.

If all that reads like a feature list without much real-world analysis, the truth is that the MX300's real-world performance isn't all that interesting. SATA SSDs such as this are a fairly mature technology, and the limitations we mentioned mean there's zero chance of this drive setting any new records. What you want is a reliable drive with no

performance nasties. That's the 2TB MX300.

In our synthetic performance tests, it delivers what you'd expect, with peak performance around 500MB/s, and 4K results in the mid-20MB/s area for reads, and 120–140MB/s for writes, depending on the benchmark app. It's a similar story of generic SATA drive performance in our real-world compression and copy benchmarks, meaning the MX300 trades on price, which is handy, because it's comfortably the cheapest 2TB SSD you can currently buy.

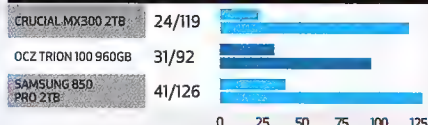
■ Jeremy Laird

LABS BENCHMARK RESULTS

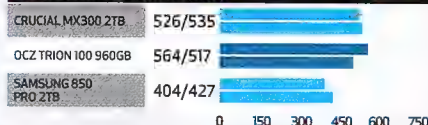
AS SSD INCOMPRESSIBLE SEQUENTIAL READ/WRITE (MB/S)



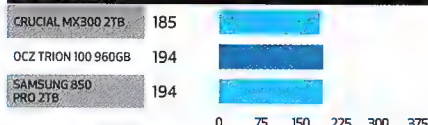
AS SSD 4K RANDOM READ/WRITE (MB/S)



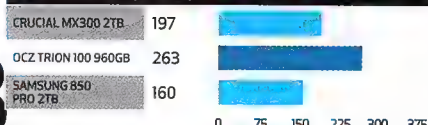
ATTO SEQUENTIAL READ/WRITE (MB/S)



5GB ZIP (SECONDS)



30GB INTERNAL COPY (SECONDS)



Verdict



Mass-storage class capacity with no performance nasties and at a very competitive price.





KEYBOARD

#229 | WWW.ROCCAT.ORG/EN-AU

Roccat Skeltr

Bringing your mobile devices to the battlefield.

The Skeltr gaming keyboard prides itself on its ability to “unite your peripherals”. Just to the right of the main power cord is a USB port designed to let you plug your mobile device in for charging. At the top of the keyboard is a ‘docking slot’ – a trench-like feature where you can pop your connected device. Our iPad stayed there quite comfortably, even when we moved the keyboard around, and the slot’s surface is coated with a rubbery substance, so your screen won’t get scratched.

The Skeltr has built-in Bluetooth and, once-paired with a phone or tablet, you can press a button on the keyboard to switch between typing on your PC or on your mobile device. We did experience a bit of latency when typing at high speed over Bluetooth, however.

The keyboard also allows you to route calls if you have a headset plugged into the 3.5mm ports, by simply pressing the Call button on

the left of the keyboard. You can also play music from your phone and the app provides oodles of settings and stats to view, too.

The build quality feels solid and the detachable palm rest is easy to switch in and out. It’s an attractive grey and black design, with three macro keys below the spacebar and another five down the left. This is not a mechanical keyboard, though – the ‘rubber dome’ membrane keys are softer to the touch and much quieter. Plus, the backlighting adds to the ease of use in low light.

The Skeltr places a great emphasis on its features, so if you’re a pro gamer, there are more appropriate options out there.

■ Carmel Sealey

Verdict

If you plan to use all its features, this keyboard is a good investment; otherwise, it’s rather expensive.



PAYAM
Data Recovery

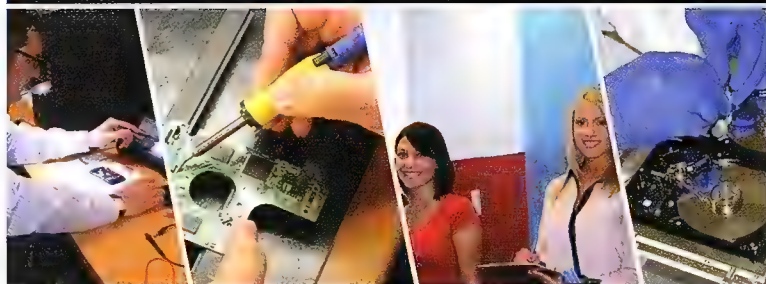
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GAMING HEADSET

\$49 | WWW.RAPOO.COM

Rapoo VPRO VH200

Cheap but not entirely cheerful.

Your humble reviewer enjoys the simple things in life – including donning a headset with media controls. The VH200 from Rapoo has just that, plus an On/Off button to control its 16 million “breathing light” colours. Another nice addition is the decent noise-cancelling microphone that retracts into the left cup – all of which can be easily found by touch alone.

The VH200’s ‘expandable bridge’ headband design won’t be to everyone’s taste – especially those who have smaller noggins. While the headset isn’t particularly heavy, its weight still causes it to slip down over time, meaning that, if you have a small head, the pressure from the cups sitting on the tops of your ears may result in soreness and discomfort. This is not an issue for those of you with bigger bread-baskets.

The cups are wide and circular, with leatherette-covered foam; however,

after an hour of listening to music with these on, your reviewer’s ears began to feel uncomfortable, due to the fact that the upper curve of our earlobes were pressed against the thin, elastic mesh covering the drivers.

Back on the positives: the sound is damned good, making these headphones pretty desirable for gaming. For music listening, they deliver warm and well-rounded bass that doesn’t drown out the mids and highs. The VH200s excel at techno and broody jazz, but suffer when playing classical, as the bass is a bit much for this genre.

The VH200s do the job well in the gaming den and they’re tantalisingly cheap; but maybe try before you buy. ■ Carmel Sealey

Verdict

For such little pocket money, you get great sound; but keep in mind the potentially uncomfortable fit.



GAMING HEADSET

\$179 | WWW.BLUEMOUTH.COM

LucidSound LS20 Powered Gaming Headset

OKish headphones for a premium.

There are loads of hybrid headsets around that promise a seamless transition between gaming and on-the-go life. One minute, you’re groaning into the mic while teabagging scrubs on Xbox Live, then you’re discussing core pillars and figures on a con-call with Shanghai.

Out of the box, the LS20 looks and feels reasonably premium given its all plastic and vinyl construction. The quilted stitching on the headband is a nice touch, but the design showstopper is the sensual split and twist where the headband meets the cans. The LS20 took a bit of coercion to find the comfy spot on the head; I think I’m still trying. The cans are a slightly weird size where they’re not on-ear, but not quite over-ear either. Thankfully, there’s enough pivot and push in the fit that you should find moderate comfort.

Over on the left side is the USB charge point, 3.5mm jack, multi-device power

switch and slot for the optional boom mic and large stop/play button. There’s also the awesome volume control, which is a sneaky dial taking up the entire left side. While over on the right is the bass boost control and mic mute.

The 40mm drivers fair averagely when used unamplified, but flick that switch, well, button... and the 40’s come to life with much needed punch and vigour.

The LS20 boasts compatibility with PS4, Xbox, mobile and PC but if you regularly use voice chat on all platforms, take note that PC compatibility means sound only... no voice, which was annoying to discover.

Sadly, the LS20 is hilariously overpriced for what you get. ■ Troy Coleman

Verdict

Punchy (when on) headphones boasting striking looks. Comms are a bit how-ya-go’in’.





GAMING MOUSE

\$150 | WWW.STEELSERIES.COM

SteelSeries Rival 700

Near mousing perfection in a non-ambidextrous form factor.

With high-dpi optical sensors now perfected, RGB lighting mastered and a plethora of mice in a variety of shapes, sizes and button layouts, it's hard to imagine where the pointy rodent will go next. Well, that's what we thought, until the Rival 700 arrived in the labs.

The choice of cable rests with the consumer. You get a 2m-long braided cable, a 1m-long plastic-coated cable, plus a shorter 90cm-long plastic-coated cable. On top of that, you can also swap out the cover on the rear belly of the mouse to either a glossy black or an anti-sweat soft-touch variant instead.

By default, the Rival 700 comes with an optical PixArt 3360, pumping out a whopping 16,000dpi if needed, with zero hardware acceleration. However, if optical isn't your jam, you can grab yourself the PixArt 9800 laser module, unscrew the case and place your new sensor inside.

You can't quite see the OLED screen above, but it enables you to slap any number of small GIFs or images on the side of the mouse, alongside in-game notifications. There's also the inclusion of rumble feedback – you can assign tactile feedback to any of the seven buttons. The vibrations are exceedingly precise, and don't cause any jitter in your mouse positioning.

All in all, the SteelSeries Rival 700 is a well-tuned, customisable gaming mouse at the pinnacle of its field, designed to incorporate absolutely everything in today's gaming mouse market. It does cost \$150, which is a lot for a pixel-pointer, but it's well worth it in our eyes. ■ Zak Storey

Verdict

With a fantastic optical sensor, and comfy and classy design, this is a great mouse for the gaming den.



PC CASE

\$99 | WWW.CORSAIR.COM

Corsair Carbide 270R

A classy chassis comprised of compromise.

Coming in at a reasonably affordable \$99, the Carbide 270R is the first Corsair case that incorporates the look and feel of the sophisticated 400C but at a more aggressive price.

The front panel curves down into a smooth, brushed aluminium-effect plastic finish, with the front I/O tucked away down the side in a recess. On either side, you'll find a large section of filtered fan intakes, around 2.5cm deep – more than enough to keep your front system fans well fed.

Speaking of cooling, there's room for a 360mm/280mm radiator in the front (three 120mm fans or two 140mm), a 240mm/280mm radiator in the roof (two 120mm/140mm) and a single 120mm radiator in the rear. Pretty neat, if water cooling is your thing.

The vent on the roof is long, but not long enough to mount three 120mm fans. Our biggest gripe with the top fan mount lies with the

fact that it has no dust filtering. The rest of the chassis is very spartan, too.

We can't help but go back to that price. For \$99, you could get NZXT's S340 case, which looks crisper and cleaner, and has better dust filtration systems than the 270R. It is, however, more limited in its cooling support. But if that's a problem, you could swap over to the Fractal Define S instead, which provides you with full unhinged access to up to two 360mm radiators top and front.

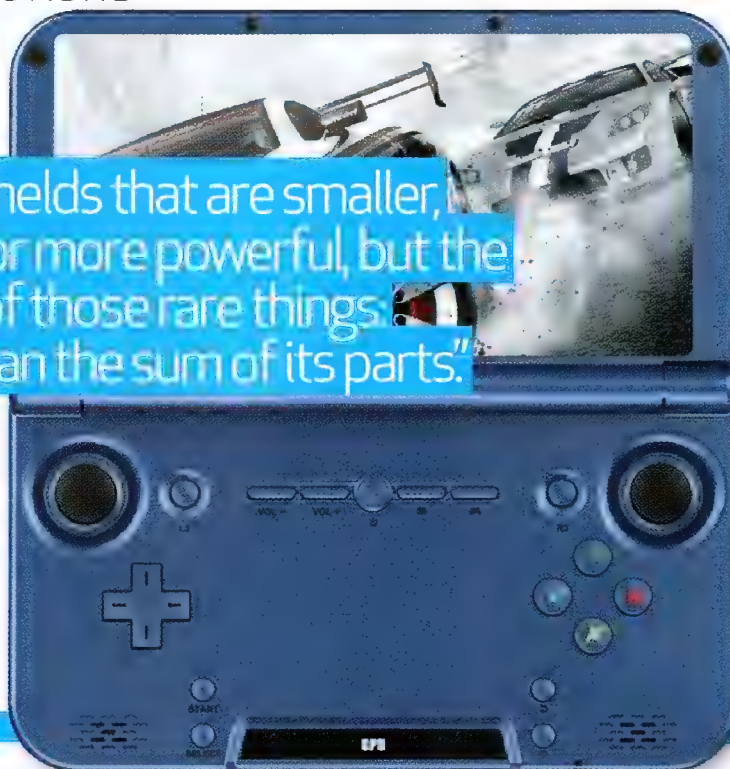
The Corsair Carbide 270R is a happy medium between the two. It's not perfect, but for the price, it's damn impressive and definitely one of our top three mid-range chassis, despite its flaws. ■ Zak Storey

Verdict

Stylish, with good cooling support and intuitive storage design; however, with some flaws.



"There are handhelds that are smaller, faster, cheaper or more powerful, but the GPD XD is one of those rare things: being greater than the sum of its parts."



ANDROID GAMING DEVICE

\$250 | WWW.MAXPIE.COM.AU

GamePad Digital XD

This gaming emulator is built into a gamepad and has garnered quite a cult following online, but is it really much cop?

You've probably not heard of the GamePad Digital (GPD) XD, but it's a device that's been getting a bit of an internet cult following. It's built into a shell that mostly resembles a Nintendo DS, but runs Android with a software package optimised for gaming (particularly emulation). Although it's Chinese-made, the build quality is solid.

New eBay prices range from \$250–\$270, depending on whether you buy the 16, 32 or 64GB version, and yes, it does have a microSD slot. Price is kept low by leaving out Bluetooth and a camera. Android is Kit-Kat 4.4.4 old.

Where the money has been spent is on the things that truly matter: the quad-core CPU, GPU, HDMI-out and a generous 2GB of RAM. This combination punches way above its weight in terms of performance – the XD can emulate surprisingly modern hardware, and it runs modern Android games

excellently. Expect around 8 hours of battery for solid, processor-intensive gaming and 10+ for lighter usage.

Minuses? Well, it's only using Android 4.4.4 – this is great for optimisation, but only time will tell whether or not needed OS updates will arrive. On top of this is a rubbish Windows 8-style interface that novices may enjoy, but anyone remotely experienced will want to change immediately to a standard Android UI.

There's also almost no documentation: the official website is a joke (complete with broken English), and if you want any information, you'll need to search YouTube, blogs and message boards.

The XD also relies on hulking monolith software like Happy Chick to deliver near-instant gaming and emulation. This is fine for anything 8- or 16-bit, but performs badly for anything more modern. It also seems rather unsafe: things that shouldn't be

available, were. Our recommendation: forget Happy Chick and install your normal, known emulator.

So how do the newer consoles stack up? Chances are smooth gaming is entirely possible for your favourite machine, but you'll probably need to tweak the settings. 3DO is great. DS is great. PS1 runs great, but experiments with PS2 were dodgy. PSP is well worth a go: some run nicely, others awfully (*Gran Turismo* being an unfortunate casualty). N64 is mostly bang on, but choose your emulator and settings wisely. Dreamcast can be graphically buggy but otherwise runs beautifully.

We're going to go out on a limb and say this is a future classic, destined to be sought after by collectors. There are handhelds that are smaller, faster, cheaper or more powerful, but the GPD XD is one of those rare things: being greater than the sum of its parts. People just want it and it's very likeable. When we walked into a local

PC outlet, all the staff members flocked around and wanted a go – many said they were going to buy one.

We feel harsh giving this a 3.5, but currently, there are just too many rough edges: it's expensive (a brand-new Nintendo Switch is \$470), it needs proper documentation provided by a native English speaker; more specific emulators with custom settings; and there are serious problems with 'bricking' regarding recharging and firmwares. If GPD fixes these things, we'll add a point or two. If it helps, think of it as a 4/5 in waiting! ■ John Knight

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

It may have become a cult favourite with its Nintendo DS-clone appeal, but it could do with some polish.



software

» APPS FOR ALL THE PLATFORMS



Windows SOFTWARE

IObit Uninstaller6

Thorough and thoughtfully designed —
IObit is the best uninstaller for Windows.

FREE | WWW.IOBIT.COM/EN/ADVANCEDUNINSTALLER.PHP



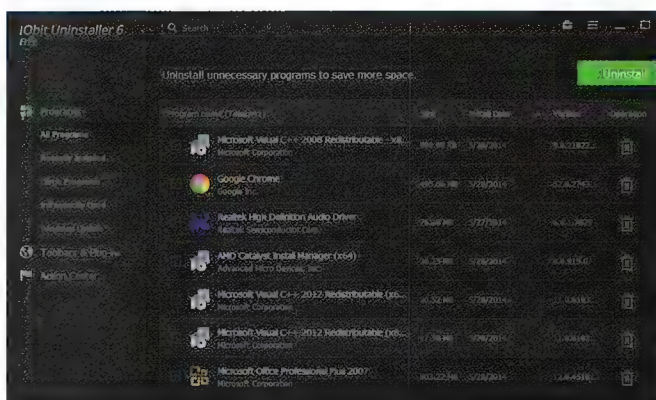
When you use a program's built-in uninstaller, it rarely does a thorough job. Sometimes, you'll be informed that "some elements could not be removed" as the uninstaller effectively shrugs its shoulders and leaves the mess behind — whether it's temporary files, old shortcuts or broken registry entries.

Third-party uninstallers can clear up the mess in moments. If you're already having trouble with a program you thought you'd removed, the tool can scan your drives for files and broken links left over.

This is a good tool for beginners, as it provides convenient lists of all recently installed programs, or old programs that you don't use very often. For more advanced users, there's also a Forced Uninstall option that allows you to locate individual programs or files and completely wipe them out.

IObit Uninstaller gets right down to business, scanning your system for installed software the moment it starts. Its smart, clear interface displays a list of all your installed software, with extra tabs if you're only interested in the newest programs (if you've tried something new and don't like it), and the biggest ones (which will have the greatest impact on system performance). There's a batch processing option for removing multiple programs at once.

If you've already uninstalled a program but suspect it's left mucky footprints across your drive, IObit's deep scanner can hunt down junk including broken shortcuts and caches created when installing software updates.



IObit Uninstaller also takes a look at your web browsers to identify any plugins that could be uninstalled to speed up your surfing. It currently supports Firefox and Internet Explorer, but not Chrome or Edge. Each extension is accompanied by a user rating to help you decide whether to keep it. There's a file shredder thrown in, too, which doesn't really fit with the premise of an uninstaller, but all the other tools are relevant and useful.

IObit Uninstaller is the best uninstaller you can download, and its thorough scanning makes it the equal of many premium programs. **Cat Ellis**

Inkscape

Create and edit your own vector graphics.

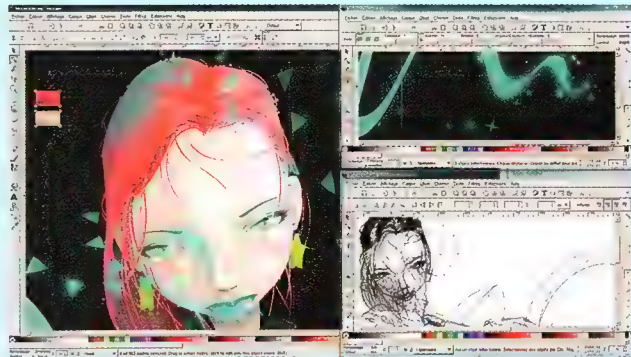
FREE | INKSCAPE.ORG/EN/



Inkscape is a great free program for creating vectors (scalable graphics that won't blur when you resize them). It's so good, in fact, that it's a serious alternative to premium tools like Adobe Illustrator. Simply put, if you can do it in Illustrator, chances are you can do it in Inkscape, and that's pretty incredible for a piece of free software. If nothing else, give it a try to see how you find it; if it's not for you, you haven't lost a thing.

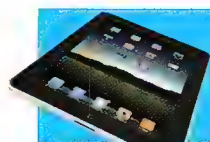
But don't think it's a pared-back, limited offering. Inkscape comes with all sorts of tools for manipulating and creating vector graphics including a large range of filters, layering tools, shapes, texts and fills.

You can also manipulate image shapes, fill them with gradients, apply filters, group them with other layers, convert them to paths, distort them and so much more. There's not enough space here to list everything that Inkscape can do,

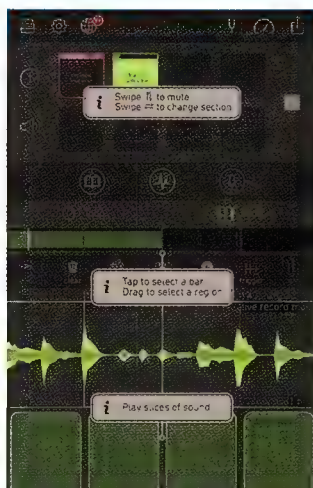


which just attests to how powerful it is. Since Inkscape is an X11 app, it runs a little slow and doesn't have the intuitive control scheme you might find from some of its commercial equivalents, but once you get the hang of it, the features and (no) cost outweigh the limitations of the interface.

Alex Blake



App Store » iOS APPS



Blocs Wave

A great music app with a toy's friendliness.

\$4.49 | BLOCS.CC



Blocs Wave is designed for fast music composition and recording, and it delivers: with two taps, we had a fantastic EDM tune playing. The app is deceptively simple. You start with six hexagonal pads, each with a different kind of instrument – drums, melody, FX, vocal, percussion and bass – and if you tap on the pad, it'll play a loop. Tap again for a different one; tap a different pad for another instrument. And that's all you need to create music.

If you're familiar with apps such as Ableton, you'll recognise the approach: you create your song as individual sections and move between them without duplicating, so instead of having the chorus in there twice, you just create it once and tap it when you want it. Bloc Wave has room for six different sections, each of which can have eight instruments, and you switch between them with a tap.

It's the kind of app that rewards experimentation. Tap the tuning fork icon and you can pitch-shift in real time; do the same with the dial icon and you can change the tempo. You can also change the volume and pan of each track, as well as cutting up sounds to make them unique. There's a basic selection of instrumental loops, and there are lots more available via IAPs. You can also record your own audio.

Bloc Wave plays well with others, too. It supports Ableton Link, so you can jam in time with Ableton users on the same network, and it also supports hardware input, Audiobus and AudioCopy/AudioShare so you can use it with other music apps. You can export as AAC or WAV and specify how many bars the song should run for, and input your own sounds via iCloud Drive or Dropbox as well as from Novation's Launchpad app. Best of all, you can export it as an Ableton Live project.

If the measure of a music app is how quickly you can make something you like, then Blocs Wave scores very highly: our productivity has plummeted as we've been engrossed in the app. It's enormous fun for amateurs and pros alike.

Gary Marshall

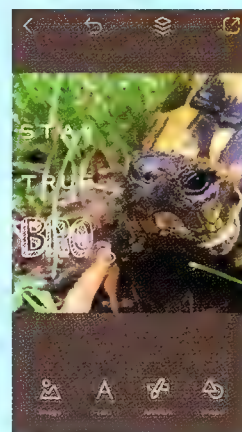
Over

Meme-ify your photo collection.

FREE WITH IAP | MADEWITHOVER.COM



This app isn't new, but it has had an update making it worthy of another look. To say this is a free app with in-app purchases seems a little untrue. Yes, you can create without paying a cent, but to unlock the true potential of this app, you'll have to reach into your wallet. One-off payments for extra fonts, drop shadow effects or graphics range from \$2.99 to \$4.49, but to unlock the full pro version, you'll have to fork out \$11.49 per month. The extra tools on offer are quite good, such as templates, the ability to use shapes, more fonts and word art, online source photography, the ability to place projects on hold and start a new one, and so on, but if you're just looking for a quick meme creator, then the free version will be more than enough.



The interface is super simple, though there doesn't appear to be any sort of tutorial. After asking for permission to peer into your phone's photo collection, you can select a picture as the background (or use the default), then set about laying over text, shape and art elements. You can easily resize and rotate everything, plus there's a handy 'undo' button at the top, too.

Whether you're looking to use this app for just a bit of fun, for designing birthday invitations or business cards, or even mocking something up for the boss, it will likely be able to help. However, if you're looking for something more feature-rich, you'll have to pay up. Carmel Sealey

OKDOTHIS

Just DO it!

FREE | WWW.OKDOTHIS.COM



There are plenty of inspiration-based apps on the market brimming with generic advice, but OKDOTHIS intends to motivate you to achieve very specific tasks, aiming for the very real goal of improving your photography chops. The premise is simple — each day when you open the app, you will get a new "DO" (the app's own vocabulary for 'goal') which will give you a particular challenge ranging from "office selfie" to "Tenebrism: Violent contrasts of light and dark, where darkness dominates the image". The social component of the app is pivotal to its success, as the DOs are actually suggested by the community itself, and the photos you eventually upload can be discussed and voted on by the same community. As a result of this, you'll see an Instagram-esque home feed, as well as the ability to search through past photos or DOs, and of course, an integrated chat and profile page. This app will flourish or fail based on the strength of its community; we hope it gets what it needs, so we can see some decent photos flooding our feeds. Harry Domanski



Spark for Mac

The impressive mobile mail client arrives on the desktop.

FREE | SPARKMAILAPP.COM



Readdle made a splash last year with Spark, a feature-rich iPhone email app that, while far from perfect at launch, quickly blossomed into one of the best mobile mail clients around.

Now Spark is coming to the desktop.

Spark for Mac isn't yet a straight port from iOS, but successfully checks off most of the key features, including Smart Inbox (which automatically sorts incoming messages), natural language search, Quick Replies and smart notifications. The macOS version also syncs existing accounts, signatures and other settings from iOS, which made our initial setup almost nonexistent.

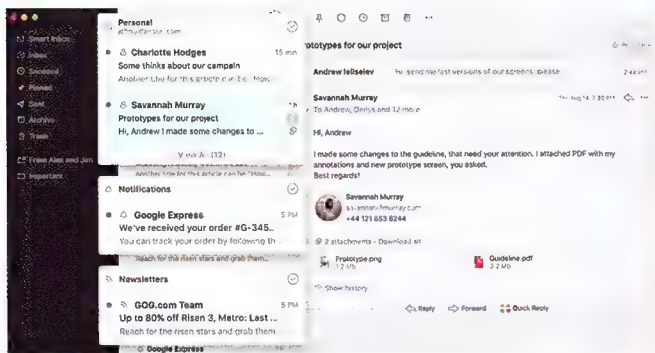
The app bears more than a passing resemblance to rival third-party email client Airmail, which itself sticks to the tri-paned playbook established by Apple Mail. Accounts and folders occupy a small dark sidebar on the left, with a list of messages in the centre that can be configured to preview up to three lines of text. The rest of the window displays full messages in a threaded, conversational view. There's no way to open individual missives here, although you can by double-clicking from the messages list. Navigation is intuitive, but Spark lacks some of Apple Mail's nicer features, such as contextual menu shortcuts or the ability to make important senders stand out with color-coded rules.

Spark makes up for this with more elaborate gestures: swipes can be configured to perform a total of four different actions (two each at left and right), including Move and Move to Spam, which we use far more than the clichéd Archive option found in modern email clients. As with Mail, it's also easy to move messages between different mail accounts — something we do daily — although Spark sometimes took upwards of 15 seconds to complete such tasks.

For a first release, Spark for Mac is impressive and, best of all, free. There are no ads or features to unlock — at least not yet. Readdle plans to eventually offer in-app extensions that add new features, and hopefully deliver feature parity for missing iOS features such as connected cloud services and sharing extension support.

Spark successfully makes the leap to macOS, but work remains before it's a match for the superior mobile version.

JR Bookwalter



Artistry Photo Pro

Instagram meets Photoshop.

\$30.99 | HELLOIAT.COM



This app wants to be the Instagram of your Mac. Getting started is easy — just open an image and choose a filter. Next, use the adjustment controls to tweak the image.

Simple numbers and sliders make the edits easy, and a series of thumbnails indicates their impact. You can also apply additional effects by selecting the 'Add Adjustment' option. There's a good selection of options available and the thumbnail makes it easy to experiment, but a couple of basic controls (crop and straighten) are missing. However, we were told an extension to connect the app to Photos is imminent, which will solve that issue.

You can paint in an effect using the controls revealed by clicking the paintbrush icon to the right of each adjustment title. There's an option to detect the edges in your image to limit changes to specific areas, but we had mixed success with it. While the selective adjustment feature can be useful, it can also get frustrating because you have to click on the brush icon twice every time you want to adjust the size, hardness or opacity of the brush, or switch to the eraser to correct a mistake.

Moreover, if you change your mind about the effect you want to use and click on a different one in the bottom row, your carefully crafted painting is lost.

Angela Nicholson



iA Writer 4

Zen and the art of focused writing.

\$14.99 | IA.NET



This app was one of the first to offer a distraction-free writing space, and it remains one of the best. Its 'you can choose any font you like as long as it's this one' approach is all about getting you to

focus on what you're writing rather than faffing around with themes and preferences.

It offers all the essentials: great export options, iCloud sync as well as Markdown formatting, and it can also help you spot language abuse such as overuse of nouns, adjectives, verbs and more.

Version 4 keeps the same minimalist interface as in previous editions, but adds some powerful new features. You can now embed images with a simple forward slash and filename, and you can do the same with text files or CSV tables. That means you can create master documents containing multiple text files (a book, say, or a lengthy report), or pull in text blocks you've saved previously. CSV embedding means your Markdown text can include properly formatted tables, which is really handy.

However, because it doesn't give you access to your Mac's file system, you need to drag images or external files to its sidebar before you can add them with a slash. That's a minor niggle; the embedding is a welcome addition to a great app.

Gary Marshall



SeaMonkey 2.46

An internet suite packed with features.

FREE | WWW.SEAMONKEY-PROJECT.ORG

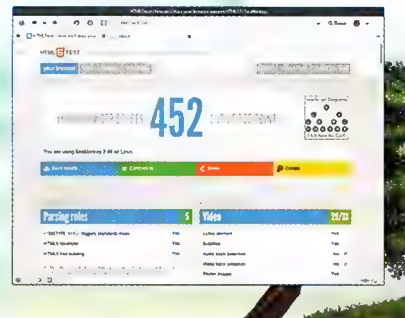
SeaMonkey, born from the classic Mozilla Suite, is one of the most complete, powerful and feature-rich browsers around today, even when put against the likes of Firefox or Chromium.

The SeaMonkey Suite consists of a web browser, email client, WYSIWIG web page composer and an address book manager. Other features can be found as add-ons from the Mozilla store, such as Chatzilla (an IRC messenger), Lightning (calendar), DOM inspector and more — many add-ons from the vast Mozilla collection are compatible with both Firefox and SeaMonkey as the browser engine code in SeaMonkey is synced with the engine from Firefox.

For instance, the latest SeaMonkey 2.46 has the same Gecko engine as

Firefox 49, so both browsers render web pages identically, in theory. SeaMonkey keeps the tradition of the classic web browser, as it was seen back in late the 1990s (no Australis-like interface, for instance). For many users, this design is more appealing than fancy modern browsers, but you can customise SeaMonkey with a custom set of useful add-ons if you wish. This way, you can bring back close buttons to tabs, turn the menu bar into a compact button and adjust the application behaviour to your liking. The essential Firefox add-ons, including the broad selection of ad blockers and audio/video downloaders are also compatible with SeaMonkey.

Apart from the browser component, the suite also has a robust email client, which works with all modern mail



services, such as Gmail. It's noticeably lighter than Thunderbird and doesn't have as many advanced features (for example, you'll need to manually fill in your incoming and outgoing server details), but it works beautifully.

The Mozilla Composer is another nice addition for those who want to study HTML basics. Simply design a page in the visual editor and explore the code in the next tab.

Alexander Tolstoy

Darktable

A photography tool for RAW processing.

FREE | WWW.DARKTABLE.ORG

If you want to get the best results out of a digital SLR camera, you'll want software to process the files. There are many applications in Linux that can process RAW files and Darktable was one of the first open source RAW tools that appeared for Linux, and while longevity doesn't always imply perfection, we believe that every Linux photo enthusiast should be aware of some of Darktable's very useful features.

Darktable works in two modes. Lighttable resembles an image viewer with thumbnail support: you select a directory with a corresponding tool on the left edge and wade through dozens of photos in order to sort out the best shots. Once you double-click an image, you're taken to darkroom mode where the magic begins.

A set of colour correction tools on the right edge of the window enable you to fix colours and produce better quality images than the default camera optimiser. You can tune shadows and highlights, fix white balance, sharpen or apply a lens mask to fix distortion and as long as RAW stores more data and preserves both details and colour dynamic range, most of your changes will be non-destructive. Based on our tests, Darktable is very robust in handling heavyweight RAW files, it easily applies all your changes with little or no delay.

The only thing you can't do inside the darkroom mode is exporting. In order to save or export your work, you need to get back to the lighttable and use the menu again on the right edge. This time, there will be tools for selecting images, editing styles metadata tags and exporting. Building Darktable from source probably isn't necessary — it's been picked up by most distros and the packages are often kept up to date. Alexander Tolstoy

Kadu

An instant messenger you didn't know you needed.

FREE | WWW.KADU.IM

This instant messenger (IM) is outstanding in many ways, and there's a good chance it's one of those overlooked applications you probably need, and not only because its rivals are weak. Kadu is a KDE-centric client for Gadu-Gadu, a popular Polish IM protocol, but you don't need to be a member of the Gadu-Gadu network, as Kadu also supports Jabber/XMPP.

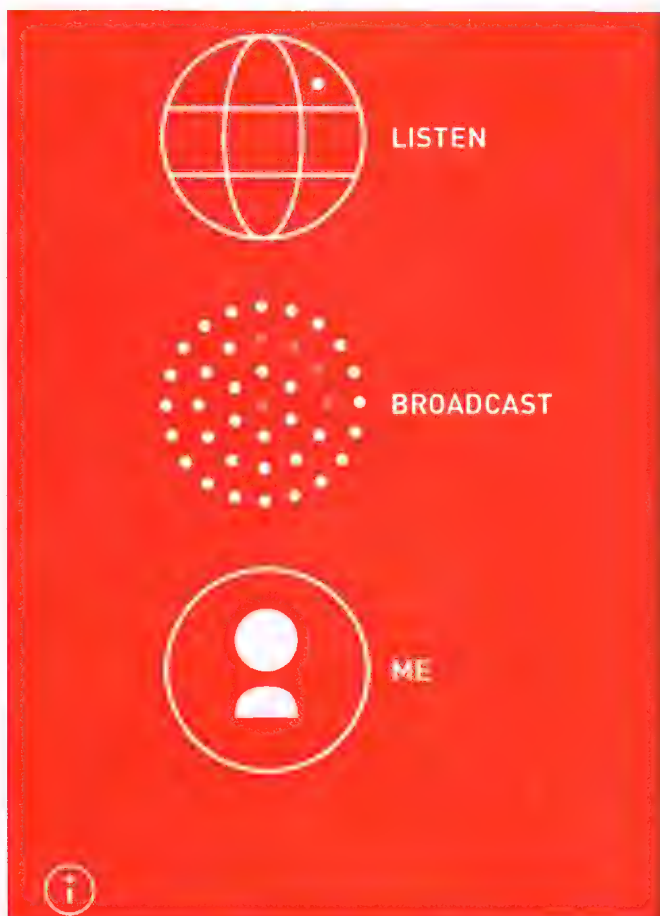
At the first look, Kadu is a typical IM client and while it's very robust, it's also remarkably comprehensive and feature-rich. However, there are very few binary packages for Kadu, so you'll probably need to build it from source and that's the point where you'll see how large its scope is. Kadu has numerous plugins and extras from MPD daemon integration (which lets your buddies know what you're listening to right now) to an optional Ubuntu Unity indicator, word replacement module, images and videos integration for the chat window.

Kadu has a lot of dependencies and it takes some time to install them all before the usual `$ cmake ..` command finishes without errors. It takes 10–20 minutes more to compile the application itself (`$ make`) and extra effort to install it to a system-wide prefix (such as `/usr`). You'll also need to rebuild your distro's `libqxmpp` package in order to prevent Kadu from crashing when you add an XMPP account.

However, Kadu is stable and well-tested in other regards and in return for your efforts you get a perfectly versatile IM client with lots of bells, whistles and extras that cater for many tastes. Kadu's interface is also very clean and polished and sports sensible placement of buttons, drop-down lists and categories. Alexander Tolstoy



Google Play » ANDROID



Mixlr

We'll do it live.

FREE WITH SUBSCRIPTION | WWW.MIXLR.COM

Mixlr is a comprehensive live audio broadcast app, designed to broadcast anything you want — podcasts, music, talk — to your friends, fans or even your own website. It doubles as a listening service, too, with the ability to search music or spoken content in different genres and follow the streamers or stations that you particularly dig. When you're done with your broadcast, you can upload a high-quality recording to SoundCloud, Mixcloud or Dropbox, rolling several different processes into the one smooth operation. Although the app features its own chat, comments and 'likes', you can still share the stream on all the regular social networks to get your sounds heard. The service allows you to stream 1 hour per day for free, or you can subscribe to one of three price tiers, giving you 3, 12, or 24 hours along with some other perks. While this app is available for both Android and iOS, the interface is considerably better on iOS and runs smoothly, the Android version still seems to have some teething issues (such as when tapping on a specific genre to listen to, it will seemingly select one at random). **Harry Domanski**

Notification Hub

A neat, widget-oriented approach to notifications.

FREE | WWW.EMBERIFY.COM



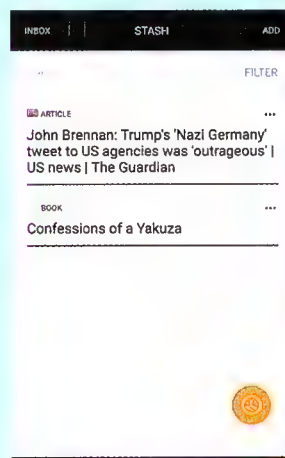
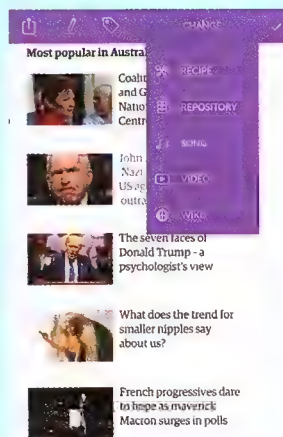
If for some reason you're unhappy with your Android phone's in-built notification management, this new app provides a pretty good alternative. Once installed, you can choose from any app on your phone which supports notifications, and have them register with this app's quite stylish and discreet front-page widget. This comes in the form of a bar which appears at the top of the phone screen, or you can open the Notification Hub app and see each notification in the order they arrived. It's possible to upgrade to the Pro version, which allows Notifications Analytics (who wants this?) and notifications based on your location (could be useful), among other things. Notification Hub does what it says on the tin, but few Android users will desperately seek an alternative to the default. Still, there must be a niche of users who do want something better, and this is a worthy (and free) option. **Shaun Prescott**

Stash

A polished and easy-to-use bookmarking and archiving app.

FREE | STASH.AI

Before you go ahead and install Stash, be aware that there's currently a waiting list to actually use it. In other words, you'll need to register your interest and wait for an invite to access this bookmarking app. Once in, you'll find a smart-looking and relatively easy-to-use interface which syncs with a Chrome extension on your desktop. From the extension, you can categorise bookmarked pages from a long list (article, book, forum and so on) and then access it from the corresponding section in the app. You can also search and bookmark pages, companies, map coordinates and more from within the app itself, though this is not very intuitive: the auto-search function would often not show the results that I was after. It's possible to save pages for offline viewing, and everything can be tagged for easy access within the app itself. It's pretty and functional — perhaps a little confusing at first — but if you're the type of person who uses bookmarking a lot, this is a good tool. **Shaun Prescott**





PINT-SIZED PCs BIG POTENTIAL

Josh Collins knuckles down in the lab to compare 12 mini desktop PCs, from NUC-a-likes to stick PCs and even a gaming model.

Electronics have shrunk as the years and decades have passed. None have more notably downsized than the personal computer, featuring a long history of first penetrating the family home and then, over the past two decades, scaling the number of PCs per home – even per room. This miniaturisation has also seen PCs increasingly seamlessly integrated into daily life, be it work, rest or play.

This digital invasion has been led by the shrinking of form factors and lowering costs. As many readers would understand, the primary desktop PC form factor is the ATX form factor. As

motherboard form factors have shrunk, so too have the chassis form factors.

Most PC enthusiasts know of form factors such as Micro-ATX and Mini-ITX, along with how these forms encouraged the adoption of early Small Form Factor (SFF) PCs. Further reduction in the form of Nano-ITX and Pico-ITX introduced the concepts of the Ultra-Small Form Factor (USFF) and Ultra-Compact Form Factor (UCFF).

In 2013, Intel took things a step further by introducing a 10cm x 10cm motherboard form factor, shoe-horning it into the UCFF category and calling it the Next Unit of Computing, or NUC for short. Since then, the mini-PC market

has grown significantly with numerous options derived from the NUC concept – we've even got a few PC-on-a-stick solutions to test, too.

Join us in the coming pages as we explore and assess a broad range of ultra-compact mini-PCs. But before we do, we'd quickly like to thank Micron-Crucial for supplying some of the test hardware used in this feature. Mini-PC vendors were requested to send units fitted-out with necessary components and test ready, but unfortunately, this wasn't possible for some, so Micron-Crucial helped out by supplying a selection of SSDs and memory to allow testing.

MINI NUC-STYLE
PCS



\$649; AS TESTED, \$1,145 | WWW.TICOMPUTERS.COM.AU

ASUS VivoMini-U UN65U

Small and mighty, punching
above its class.

The most NUC-like unit from the ASUS mini-PC range, the VivoMini-U UN65U adopts similar physical dimensions to Intel's models while also implementing laptop hardware tech repurposed for the desktop, and delivers an enjoyable, fuss-free experience.

The UN65U's compact exterior belies the truth of its significant processing power encapsulated within. Admittedly, the Core i7-7200U used in this unit is an ultra-low power SKU with a cut-down dual-core, four-thread count versus the typical quad-core, eight-thread count found within Core i7 SKUs conforming to a higher TDP. Yet, the 3.1GHz boost clock on the Core i7-7200U ensures strong single-threaded performance, a notion backed by the Cinebench R15 Single Core test result.

Aiding the Core i7-7200U in our test unit (and surprising us with some big

performance from a small package) was 16GB of DDR4-2133 RAM split across two 8GB SO-DIMMs, paired with a Samsung 960 Evo 256GB M.2 NVMe SSD. The NVMe SSD delivered unparalleled storage performance against the competition, with the exception of the Intel Skull Canyon NUC, whose Samsung 950 Pro stretched the storage performance margin a bit further. Still, with that 960 Evo partnered by a 500GB Western Digital 5,400rpm HDD, there's plenty of storage – both fast and dense – to care for most user needs if you want to buy this one prebuilt.

This is a competent mini-workstation for users focused on CPU and storage performance.

Verdict

A tidy little unit packing more of a punch than it lets on.



\$699; AS TESTED, \$1,015 (BASED ON TI COMPUTERS MODEL USING A CRUCIAL MX300 275GB SSD) | WWW.ASUS.COM/AU

ASUS VivoMini-V VC65R

Chunkier than most mini-PCs,
but for good reason.

The VivoMini-V VC65R is an unassuming wolf in sheep's clothing, in respect to the versatility of implementation provided by the modular design, which allows for multiple chassis configurations.

The options are numerous, starting with a slimmer dual 2.5-inch drive option. Next, the slightly larger solution featuring dual 2.5-inch drive support, plus optical drive, followed by a third option similar to the second, but with support for an additional dual 2.5-inch drive to replace the ODD. The third config facilitates the use of four 2.5-inch drives in this mini-PC – significant storage density potential within a small footprint is well within scope of this unit!

The sample we had in for testing was supplied by ASUS and featured a Samsung 750 Evo 120GB SSD for the operating system and a Seagate 1TB SSHD for general storage. It used that second chassis

option and therefore included a DVD-RW, too – a Hitachi-LG Data Storage (HG-DT-ST) GUE1N DVD-RW.

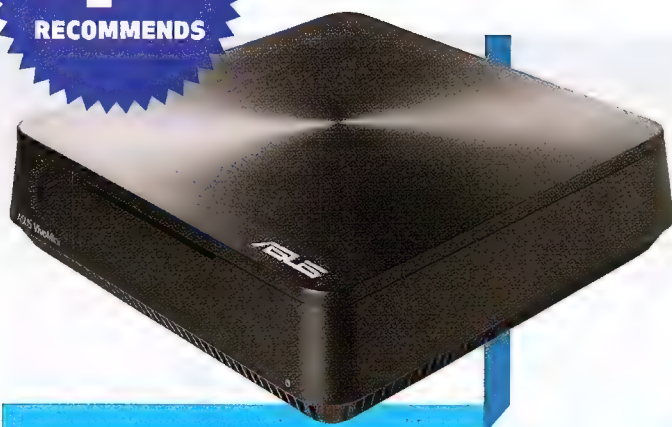
Unlike the other mini-PCs, the VC65R features a COM port. Some may scoff at this I/O inclusion, but for many industrial and commercial applications a COM port is essential for communicating with pre-existing, older hardware and specialty solutions. Additionally, the internally-embedded power supply removes potential trip hassles or external points of failure for the unit – another plus for commercial and industrial applications.

Overall, this is a neat bit of kit with a few tricks the competition can't match.

Verdict

Unexpected versatility in modular design and configurations make this a great little PC.





\$759; AS TESTED, \$1,099 (BASED ON TI COMPUTERS MODEL USING 2 CRUCIAL MX300 275GB SSDS) | WWW.ASUS.COM/AU

ASUS VivoMini-V VM65N

Mobile tech on your desktop.

The VivoMini-V VM65N implements mobile laptop hardware into a mini-PC form factor driven by applied simplicity.

It has a beautifully minimal chassis, with circular brushed aluminium finish on the top. The top slides off with a tool-less design revealing an option to install either a single 3.5-inch storage device or two 2.5-inch ones. Under the storage compartment is a small latch for access to the SO-DIMM RAM installation slots.

The sample we tested featured two 2.5-inch Samsung 750 Evo 120GB SSDs in RAID 0. While those solid-state drives are a bit dated, it didn't stop that RAID 0 setup from getting up near the 1GB/s transfer speed for sequential read and write, hitting approximately 925MB/s read and 940MB/s write speeds — the increased speeds particularly demonstrating a direct benefit of the RAID 0 config.

The I/O fit-out is strong too, with six USB ports (four USB 3.0, two USB 3.1), DisplayPort, HDMI, Ethernet port and a 4-in-1 card reader. Those in the market for a new barebone HTPC solution will appreciate the S/PDIF output for linking to a hi-fi or home theatre audio setup.

Drawing on its mobile hardware roots, the VM65N features an Nvidia GeForce 930M GPU, though don't expect HD gaming with all the eye candy on max. The platform implements a hybrid GPU switching mechanism, using the CPU's iGPU when under light load or idling, then engaging the Geforce 930M when required. This significantly reduces the platform power usage for lighter tasks.

Verdict

Good spec, pleasant aesthetics and sufficient I/O to make for a neat media PC or all-rounder mini-PC.



\$749 (GB-BKi7HA-7500); AS TESTED, \$1,134 | WWW.GIGABYTE.COM/AU

Gigabyte BRiX S GB-BSi7HA-6600

Pipped at the post.

During the benchmarking phase of reviewing this unit, we were informed that the device would be EOL by the time you read this review.

Typically, we don't include products destined for computer heaven in the magazine, or those that aren't available in the local market. We were informed in the same conversation that the GB-BSi7HA-6600 would be replaced with the GB-BKi7HA-7500, a Kaby Lake refresh of the product that otherwise features the same chassis and I/O connectivity as this model — only now featuring the Core i7-7500U with the Kaby Lake GT2 Intel HD Graphics 620 based iGPU core instead of the Skylake GT2 Intel HD Graphics 520 found in the Core i7-6600U.

We looked into the CPUs used and they're very similar. Next, we were told the GB-BKi7HA-7500 would be arriving at \$749. A quick bit of market research showed the model below the

one we have tested (the GB-BKi7HA-6500U) is selling for \$765–\$779 at the time of writing. By the time you read this, the GB-BKi7HA-7500 should be prevalently available and the results from the benchmarks of the GB-BSi7HA-6600 will give a close indication of performance due to the 100MHz operating differences and lack of significant difference in IPC processing power between Skylake and Kaby Lake generation CPUs.

The BRiX S delivers an exceptional NUC-like unit to market; however, it's beaten in the value stakes by the MSI Cubi 2 (flick over to page 45 for our review).

Verdict

A great little unit, but unfortunately its limelight has been stolen by MSI's Cubi 2.





\$1,249 | WWW.GIGABYTE.COM.AU

Gigabyte BRiX Gaming UHD GB-BNi7HG4-950-MF

A workstation or gaming mini-PC?

This mini-PC is a peculiar one. The product is pitched as a gaming product, yet it has a minimalistic appeal typically associated with professional-focused products with sleek angles and brushed aluminium surfaces that contrast with piano black end caps. Is Gigabyte using the 'gaming' moniker for SEO-driven reasons?

The GB-BNi7HG4-950-MF brings to the table a unique hardware attribute, though: a desktop-derived discrete GPU in the form of a GeForce GTX 950. This certainly brings some gaming chops to this product compared with others in the roundup, but we think someone at Gigabyte was having a laugh the day they associated UHD gaming with a GTX 950. But this unit happily smashes out less demanding games or with some lowering of graphics settings in more recent titles at 1080p.

The I/O options on this unit are significant

compared with other units here. Most notably this Brix has four graphics outputs in the form of three mini-DisplayPort and one HDMI interface thanks to the GeForce GTX 950. This also allows four simultaneous video outputs.

Though pitched as a gaming unit, performance output, aesthetic appeal, small footprint and sufficient connectivity could see this mini-PC suitably placed on the desk of a creative professional. However if you're a video producer, be mindful that the cooling revved up quite a racket during the X265 4K benchmark.

The price is a little steep, but that's expected for a mini-PC dabbling in gaming.

Verdict

Capable, sleek, poised to compute and a little on the rich side.



\$349 | WWW.INTEL.COM.AU

Intel NUC5PGYH

With the DNA of the original NUC, is it the best?

This specific Intel sixth-gen NUC, the NUC5PGYH, provides a straight-from-box hardware solution but also has an operating system pre-installed.

The OS is installed to a 32GB eMMC storage solution. While it may appear as an elegant implementation at first, the 32GB eMMC is slow compared to SSDs using the SATA protocol and delivers performance akin to a spinning disk drive. Furthermore, once the OS is installed, the unused space available for applications, additional drivers and so on is already below 20% of the total drive capacity. This issue can be relatively easily averted by installing a 2.5-inch drive as we did during the labs testing.

With the Crucial MX300 525GB 2.5-inch SSD, the user experience was vastly improved due to the increased storage space. We would like to see this unit refreshed with a 64GB

eMMC module, or perhaps another slightly higher spec option with M.2 support for a SATA-based M.2 SSD. Obviously both of these directions would increase the price. The increased storage would improve the user experience as well as help to maintain platform performance reducing storage slowdown as the SSD nears full capacity; not to mention that uneasy feeling of insufficient storage space would subside.

This is a great little unit for a networked thin client, especially with the 8GB RAM, but for home users, they may be better off with the NUC5PPYH (over the page) to facilitate custom setup and remove the eMMC storage bottleneck.

Verdict

A great option for a networked thin client, but limited 32GB capacity will bother some.



VENDOR	ASUS VIVOSTICK TS10	ASUS VIVOMINI-U UN65U	ASUS VIVOMINI-V VC65R	ASUS VIVOMINI-V VM65N	GIGABYTE BR1X 5 GB-BS17HA-6600	GIGABYTE BR1X GB-BN17HG4-950-MF
STREET PRICE	\$189	\$649	\$699	\$759	\$749^	\$1,399
PRICE AS TESTED	\$189	\$1,145	\$1,015*	\$1,099*	\$1,134	\$1,654
DIMENSIONS (MM - HXWXD)	16.5 X 135 X 36	52 X 131 X 131	61.9 X 197.5 X 196.3	56.2 X 190 X 190	46.8 X 112.6 X 119.4	220 X 110 X 110
CHIPSET	BRASWELL	KABY LAKE-Y PCH	INTEL H170	SKYLAKE-Y PCH	SKYLAKE-U	INTEL HM170
CPU MODEL	INTEL ATOM X5-Z8350	CORE I7-7200U	CORE I5-6400T	CORE I5-6200U	CORE I7-6600U	CORE I7-6700HQ
RAM TYPE	DDR3 X1 (INTEGRATED)	DDR4 50-DIMM X 2	DDR3 50-DIMM X 2	DDR4 50-DIMM X 2	DDR4 50-DIMM X 2	DDR4 50-DIMM X 2
MAX. DENSITY	2 GB	32 GB (2 X16 GB)	16 GB (2 X8 GB)	32 GB (2 X16 GB)	32 GB (2 X16 GB)	32 GB (2 X16 GB)
RAM MODE TESTED	SINGLE CHANNEL	DUAL CHANNEL	SINGLE CHANNEL	DUAL CHANNEL	DUAL CHANNEL	SINGLE CHANNEL
GRAPHICS CARD USED	INTEL HD GRAPHICS 400	INTEL HD GRAPHICS 620	INTEL HD GRAPHICS 530	NVIDIA GEFORCE 930M & INTEL HD GRAPHICS 530	INTEL HD GRAPHICS 520	GEFORCE GTX 950
VESA MOUNTABLE	NO	YES	YES	YES	YES	NO
STORAGE - MODEL	HYNIX HB64E (INTEGRATED)	SAMSUNG EVO 960	SAMSUNG EVO 750	2 X SAMSUNG EVO 750 (RAID 0)	CRUCIAL MX300	TRANSCEND MT5800
STORAGE - COMMUNICATION PROTOCOL	EMMC	NVME	SATA3	SATA3	SATA3	SATA3
STORAGE - DENSITY	32 GB	256 GB	120 GB	120 GB	525 GB	128 GB
STORAGE - FORM FACTOR	EMMC	M.2	2.5"	2.5" (2 X)	2.5"	M.2
WIRED LAN MODEL & TYPE	-	REALTEK RTL8111H (1GBPS NIC)	REALTEK RTL8111H (1GBPS NIC)	REALTEK RTL8111H (1GBPS NIC)	INTEL I219LM (1GBPS NIC)	INTEL I219LM (1GBPS NIC)
WLAN	QUALCOMM ATHEROS QCA9377 DUAL BAND WIRELESS-AC	INTEL 7265 DUAL BAND WIRELESS-AC	INTEL 7265 DUAL BAND WIRELESS-AC	INTEL 7265 DUAL BAND WIRELESS-AC	INTEL 8260 DUAL BAND WIRELESS-AC	INTEL 8260 DUAL BAND WIRELESS-AC
AUDIO	INTEL SST AUDIO DEVICE (WDM)	INTEL DISPLAY AUDIO	INTEL DISPLAY AUDIO	ASUS SONIC MASTER AUDIO (REALTEK ALC3236)	REALTEK HIGH DEFINITION AUDIO (REALTEK ALC255)	REALTEK HIGH DEFINITION AUDIO (REALTEK ALC255)
AUDIO PORTS	3.5MM AUDIO: 1X IN/OUT	3.5MM AUDIO OUT	3.5MM AUDIO: 1X OUT & 1X IN	3.5MM AUDIO: 1X OUT & 1X IN; 1X S/PDIF OUT	3.5MM AUDIO: 1X IN/OUT	3.5MM AUDIO: 1X OUT & 1X IN
FRONT USB PORTS	1X USB 3.0/1X USB 2.0/1X MICRO-USB (POWER)	2X USB 3.0	2X USB 3.0	NONE	2X USB 3.1 (1X TYPE-C, 1X TYPE-A)	-
REAR USB PORTS	NONE	2X USB 3.0	4X USB 3.0	2X USB 3.1, 4X USB 3.0	2X USB 3.0	3X USB 3.0, 2X USB 3.1 (1X TYPE-C, 1X TYPE-A)
DISPLAYPORT	-	1X	1X	1X	1X (MINI DP)	3X (3X MINI DP)
HDMI	1X	1X	1X	1X	1X	1X
VGA	-	-	1X	-	-	-
MISCELLANEOUS I/O	-	4-IN-1 CARD READER (SD/SDHC/SDXC/MMC)	COM PORT (SERIAL PORT), DVD-RW	4-IN-1 CARD READER (SD/SDHC/SDXC/MMC)	-	2 X 802.11AC ANTENNAE
SUPPORT FOR SECURITY LOCKING	YES	YES	YES	YES	YES	YES
POWER SUPPLY	18 W POWER ADAPTER	65 W POWER ADAPTER	90 W POWER ADAPTER (EMBEDDED)	90 W POWER ADAPTER	65 W POWER ADAPTER	180 W POWER ADAPTER

LABS TEST RESULTS						
PCMARK 8 HOME (ACCELERATED) - FINAL SCORE	1383	3628	3211	3460	3634	3845
HWBOT X265 BENCHMARK - 1080P (FPS)	1.58	7.49	10.72	7.1	8.9	14.71
HWBOT X265 BENCHMARK - 4K (FPS)	0.23	1.3	1.97	1.34	1.59	2.9
CINEBENCH R15 - OPENGL	9.42	41.1	34.62	54.59	48.57	100.17
CINEBENCH R15 - CPU (MULTI-THREADED)	102	297	419	294	351	679
CINEBENCH R15 - CPU (SINGLE-CORE)	31	129	120	118	143	130
CRYSTALDISKMARK 5 - SEQUENTIAL Q32T1 READ (MB/S)	135.7	1843	535.9	924.6	518.5	539
CRYSTALDISKMARK 5 - SEQUENTIAL Q32T1 WRITE (MB/S)	69.52	1397	488.4	939.2	484.3	209.2
3DMARK (2013) - FIRE STRIKE (1080P) - FINAL SCORE	175	938	684	1356	989	5298
3DMARK (2013) - SKY DIVER (1080P) - FINAL SCORE	808	3915	3203	5342	4106	17047
3DMARK (2013) - CLOUD GATE (720P) - FINAL SCORE	1423	6318	5294	6191	6875	18676
3DMARK (2013) - ICE STORM EXTREME (1080P) - FINAL SCORE	11478	43206	33627	41623	48202	91957

VENDOR	INTEL NUC5PGYH	INTEL NUC5PPYH	INTEL SKULL CANYON NUC6I7KYK	INTEL COMPUTE STICK STK1AW32SC	INTEL COMPUTE STICK STK2M3W64CC	MSI CUBI 2
STREET PRICE	\$349	\$259	\$899	\$195	\$570	\$649
PRICE AS TESTED	\$349; WITH MX300 SSD, \$549	\$559	\$1,258	\$195	\$570	\$788
DIMENSIONS (MM - H X W X D)	52 X 111 X 115	52 X 111 X 115	28 X 211 X 116	12 X 38 X 113	12 X 38 X 114	32.6 X 112.2 X 115.2 (M.2 SKU; 42.7H 2.5" SKU)
CHIPSET	BRASWELL HOST BRIDGE	BRASWELL HOST BRIDGE	SKYLAKE-H	BRASWELL	SKYLAKE-U	H110
CPU MODEL	PENTIUM N3700	PENTIUM N3700	CORE I7-6770HQ	ATOM X5-Z8300	CORE M3-6Y30	CORE I7-7500U
RAM TYPE	DDR3 SO-DIMM X1	DDR3 SO-DIMM X1	DDR4 SO-DIMM X 2	DDR3 X 1 (INTEGRATED)	DDR3 X 2 (INTEGRATED)	DDR4 SO-DIMM X 2
MAX. DENSITY	8 GB (1 X 8 GB)	16 GB (2 X 8 GB)	32 GB (2 X 16 GB)	2 GB	4 GB	32 GB (2 X 16 GB)
RAM MODE TESTED	SINGLE CHANNEL	SINGLE CHANNEL	DUAL CHANNEL	SINGLE CHANNEL	DUAL CHANNEL	SINGLE CHANNEL
GRAPHICS CARD USED	INTEL HD GRAPHICS	INTEL HD GRAPHICS	INTEL IRIS PRO GRAPH- ICS 580	INTEL HD GRAPHICS	INTEL HD GRAPHICS 515	INTEL HD GRAPHICS 620
VESA MOUNTABLE	YES	YES	YES	NO	NO	YES
STORAGE - MODEL	HYNIX HBG4E (INTE- GRATED)	CRUCIAL MX300	SAMSUNG 950 PRO	SANDISK DF4032 (INTE- GRATED)	KINGSTON M52564 (INTEGRATED)	TRANSCEND TS256GMTS400
STORAGE - COMMUNICA- TION PROTOCOL	EMMC	SATA3	NVME	EMMC	EMMC	SATA3
STORAGE - DENSITY	32 GB	525 GB	256 GB	32 GB	64 GB	256 GB
STORAGE - FORM FACTOR	EMMC	2.5"	M.2	EMMC	EMMC	M.2
WIRED LAN MODEL & TYPE	REALTEK RTL8111H (1GBPS NIC)	REALTEK RTL8111H (1GBPS NIC)	INTEL I219LM (1GBPS NIC)	-	-	REALTEK RTL8111H (1GBPS NIC)
WLAN	INTEL 3165 DUAL BAND WIRELESS-AC	INTEL 3165 DUAL BAND WIRELESS-AC	INTEL 8260 DUAL BAND WIRELESS-AC	INTEL 7265 DUAL BAND WIRELESS-AC	INTEL 8260 DUAL BAND WIRELESS-AC	INTEL 3168 DUAL BAND WIRELESS-AC
AUDIO	INTEL DISPLAY AUDIO	INTEL DISPLAY AUDIO	REALTEK ALC233	INTEL SST AUDI DEVICE (WDM)	INTEL DISPLAY AUDIO	INTEL DISPLAY AUDIO
AUDIO PORTS	3.5MM AUDIO: 1X IN/ OUT; 1X OPTICAL OUT	3.5MM AUDIO: 1X IN/ OUT; 1X OPTICAL OUT	3.5MM AUDIO: 1X OUT; 1 X OPTICAL OUT	AUDIO OUT VIA HDMI	AUDIO OUT VIA HDMI	3.5MM AUDIO: 1X OUT & 1X IN
FRONT USB PORTS	2 X USB 3.0	2 X USB 3.0	2 X USB 3.0	1 X USB 3.0, 1 X USB 2.0	1 X USB 3.0 ON STICK / 2 X USB 3.0 ON HUB	2 X USB 3.0 (1 X TYPE-C)
REAR USB PORTS	2 X USB 3.0	2 X USB 3.0	2 X USB 3.0	-	-	2 X USB 3.0
DISPLAYPORT	-	-	2 X (1 X MINI DP; 1 X DP VIA THUNDERBOLT 3.0 REAR TYPE-C)	-	-	1 X (MINI-DP)
HDMI	1X	1X	1X	1X	1X	1X
VGA	1X	1X	-	-	-	-
MISCELLANEOUS I/O	SDXC SLOT WITH UHS-I SUPPORT	SDXC SLOT WITH UHS-I SUPPORT	SDXC SLOT WITH UHS-I SUPPORT; THUNDER- BOLT 3.0 (REAR USB 3.1 TYPE-C)	MICRO SD CARD SLOT, MICRO-USB POWER PORT	MICRO SD CARD SLOT; USB TYPE-C POWER PORT	-
SUPPORT FOR SECURITY LOCKING	YES	YES	YES			YES
POWER SUPPLY	65 W POWER ADAPTER	65 W POWER ADAPTER	120 W POWER ADAPTER	15 W POWER ADAPTER	20 W POWER ADAPTER	65 W POWER ADAPTER

LABS TEST RESULTS						
PCMARK 8 HOME (AC- CELERATED) - FINAL SCORE	1764	1771	4236	1374	2715	3467
HWBOT X265 BENCH- MARK - 1080P (FPS)	N/A	N/A	16.98	1.1	4.41	7.57
HWBOT X265 BENCH- MARK - 4K (FPS)	N/A	N/A	2.97	0.18	0.83	1.37
CINEBENCH R15 - OPENGL	14.49	14.88	81.42	N/A - 64-BIT TEST	17.29	39.31
CINEBENCH R15 - CPU (MULTI-THREADED)	142	144	679	N/A - 64-BIT TEST	157	316
CINEBENCH R15 - CPU (SINGLE-CORE)	38	39	149	N/A - 64-BIT TEST	85	147
CRYSTALDISKMARK 5 - SEQUENTIAL Q32TI READ (MB/S)	134.6	528.7	2029	158.9*	229.1	538.3
CRYSTALDISKMARK 5 - SEQUENTIAL Q32TI WRITE (MB/S)	83.57	510.6	951	70.1*	71.7	300.2
3DMARK (2013) - FIRE STRIKE (1080P) - FINAL SCORE	266	285	1910	215	502	785
3DMARK (2013) - SKY DIVER (1080P) - FINAL SCORE	1146	1301	7519	909	2048	3732
3DMARK (2013) - CLOUD GATE (720P) - FINAL SCORE	1979	2238	11635	1606	3490	5858
3DMARK (2013) - ICE STORM EXTREME (1080P) - FINAL SCORE	19481	18056	68273	14021	24756	37714

* BASED ON CONFIGURATION WITH 2 X CRUCIAL MX300 275GB (2.5-INCH); SAMSUNG 750 EVO IS NO LONGER SOLD.

^ PRICE OF NEW MODEL WITH CORE I7-7500 CPU



\$259; AS TESTED, \$378 | WWW.INTEL.COM.AU

Intel NUC5PPYH

A sibling of the NUC5PGYH, better suited for DIY implementation.

With the NUC5PPYH and NUC5PGYH, essentially only one thing is different with both the model and spec – the inclusion of the eMMC storage in the NUC5PGYH, and a single letter change in the model number. It can be argued that an 8GB SO-DIMM in the NUC5PGYH is another difference; however, this is less relevant, as it can be swapped out with ease, unlike the eMMC that would require de-soldering the FBGA connection to remove the device.

Like the majority of the samples tested in this roundup, the NUC5PPYH includes a VESA mounting kit. This allows the unit to be installed on a VESA-compliant bracket. This could mean attaching the unit to the back of a suitable display – the most common VESA mount application – or perhaps in other VESA mounted scenarios such as on a moveable monitor arm or perhaps simply to a

wall using the VESA mounting plate.

Front and rear I/O is sufficient, presenting the typical NUC dual front USB and a 3.5mm jack for audio in/out through a single 3.5mm jack connection. On the rear again, the typical NUC I/O is presented in the form of two USB 3.0 ports, VGA-out, HDMI-out, an Ethernet port, the power-in socket and an optical audio link. This I/O combo provides flexibility to move between usage scenarios such as home VOD streamer, networked think client, commercial use or office PC.

If the eMMC found in the NUC5PGYH turns you off, take a look at the NUCPPYH plus some of your own preferred additional components.

Verdict

An alternative option to the NUC5PPYH if you plan to use a 2.5-inch primary drive for the OS.



\$899; AS TESTED, \$1,258 | WWW.INTEL.COM.AU

Intel Skull Canyon NUC6i7KYK

Is this Devil's Canyon and Skull Trail's baby? Not quite.

When Intel has a product it thinks is 'hot' or needs a bit of hype generated around it, the firm typically gives it an outrageous name – something like the Bad Axe, the Skull Trail or the Devils Canyon. Whatever it is, when Intel applies an unusual product moniker, in this case "Skull Canyon", people take note – but why?

There's a collection of attributes that makes the Skull Canyon interesting. First and foremost is the use of the Core i7-6770HQ mobile processor containing Intel's high-end Iris Pro Graphics 580 integrated GPU (iGPU). This iGPU is part of a unique group in Intel's CPU-iGPU range as it sports eDRAM.

The eDRAM is an on-die extended system RAM block that effectively acts as a massive cache for the iGPU and a straight-shot communication with the CPU. Additionally, the CPU die space has extra space dedicated to the iGPU. These

attributes combine to effectively elevate the iGPU to the performance of an entry-level discrete GPU (dGPU). For comparison, just look at the Skull Canyon versus the VM65N with its GeForce 930M in 3DMark – the Skull Canyon is faster! It's no GTX 1080, but for an iGPU, it is impressive and allows for less graphically intensive games like CS:GO to play well without a dGPU.

Add support for dual M.2 NVMe PCIe x4 SSD, a quad-core, eight-thread CPU boosting to 3.5GHz and a Thunderbolt 3.0 port capable of supporting a 40Gbps link to an external dGPU caddy, pack it all into a slender, aesthetically pleasing form and you have the uniquely spec'ed and capable Skull Canyon NUC.

Verdict

A neat piece of hardware kit and history, with a few tricks up its sleeve.





WITHOUT OS, \$649; WITH WINDOWS 10 HOME, \$788 | AU.MSI.COM

MSI Cubi 2

A dynamic chassis makes for a capable unit.

Like the UN65U and BRiX S, the MSI Cubi 2 is another major vendor's take on Intel's NUC concept. The Cubi 2 is significantly thinner than the square-based competition. The unit was bested in height by the Skull Canyon sixth-gen NUC, though its base footprint is almost twice that of the Cubi 2.

The unit is able to achieve its thin presence with two smart design choices. The first step was making the primary storage spec a M.2 drive — the test unit contains a Transcend MTS400 256GB SSD communicating over the SATA protocol. The second step is a clever approach to the chassis base. Bundled with the Cubi 2 is an alternative base that increases the unit's height by 10.1mm and thereby accommodating support for a 2.5-inch storage solution to join the M.2 drive.

It's fair to think that, with pushing the boundaries in height and general volume

found in the Cubi 2 — or lack thereof — the unit may suffer from heat-related issues. And while, yes, the unit did get warm to the touch when under load, so did many of the other units during testing. While there was a discernable change in volume between idle and load, it was not intrusive or obnoxious.

For today's computing environment, we would've preferred an 8GB RAM spec rather than 4GB, though fixing this should only require a ~\$50 outlay for another 4GB SO-DIMM to place in dual channel mode.

With only the OS required out of the box and competitively priced, the Cubi 2 represents good value and performance.

Verdict

A solid unit in performance and build, plus well priced, requiring only the OS of your choice.



\$189 | WWW.ASUS.COM/AU

ASUS VivoStick TS10

Stick it to your dumb-TV.

Measuring 18mm longer than the equivalent Intel Compute Stick (see the next page), this doesn't impede on the TS10 presenting a diminutive footprint. By comparison with the Intel TK1AW32SC, the attention to design details of the TS10 delivers a solution that both looks and feels nicer.

The TS10 suffers from the same resource restrictions as the STK1AW32SC. This statement rings true whether the comparison is in relation to the specific processing power, memory density, storage speed and density, or peripheral connectivity.

Buying into this solution requires understanding these shortcomings and the impact on general user experience. Due to having only 2GB of memory, multitasking capability is significantly limited. Thanks to the Atom CPU, the processing power is constrained. With only a 32GB eMMC drive, both the

storage performance and available disk space are low. No significant computing will take place on this unit.

USB connectivity is limited to two ports. This creates a conundrum for many users, especially those without Bluetooth peripherals.

So what's good? Well, it's an interesting new computing frontier and one that is set to improve significantly as the associated technologies evolve. Also, there are other handy inclusions such as the 3.5mm mic-in/audio-out combo lacking on the Intel equivalent, though photographers will likely prefer the SD card slot on the Intel unit.

For now, we'd wait to explore generation two.

Verdict

A nice bit of kit, though it's perhaps best to wait for the second-gen version.





\$195 | WWW.INTEL.COM.AU

Intel Compute Stick STK1AW32SC

Neat idea, half-baked implementation.

The Intel Compute Stick STK1AW32SC brought forward an idea that had been established for some time by DIY and SoC electronics enthusiasts – the PC-on-a-stick. This introduction created a buzz amongst PC tech enthusiasts, thrilled to explore a new space within computing.

However, for many that got to use the STK1AW32SC, the experience has been lacklustre. It is still 'nerd cool', but lacks the ease of use, performance and connectivity that users require and to a degree expect.

One of the biggest shortcomings is the 32GB of eMMC integrated storage that includes the operating system installation. This results in little space leftover for applications, file storage and so on. This is a significant issue on the ASUS VivoStick TS10 and then complicates the USB connection availability. Thankfully, this is less of an issue for the STK1AW32SC

due to a micro SD card slot that supports up to 128GB of storage. Sure, it's not fast storage, but it's a significant increase in capacity and significantly decreases the hassles associated with storage.

The micro SD slot is a welcomed feature, though it's a tough pick between this and the VivoStick TS10. Essentially, both units have undesirable traits.

Comparatively, the STK1AW32SC has no 3.5mm audio in-out support and also sports a slightly slower processor, featuring the Atom x5-Z8300 versus the Atomic x5-Z8350 in the TS10. It's not a huge frequency difference – only 80MHz – but at this level every bit of processing power helps.

Verdict

One of the early adopters and tech enthusiasts looking for a relatively cheap new tech toy.



\$570 | WWW.INTEL.COM.AU

Intel Compute Stick STK2m3W64CC

A second-gen stick that shifts things into higher gear.

Now we're talking! This is the Intel Compute Stick we were looking for! Featuring an Intel Core m3-6Y30 as the brain of the device, this provides two cores and four threads operating within a wide operating frequency band of 0.9–2.2GHz allowing the unit to adjust its thermal output between 3.8–7W dependent on workloads. This CPU selection provides the second-gen Compute Stick with some much needed computing power, resulting in an improved user experience over the first-gen offerings, especially regarding multi-threading.

Another step in the right direction was taken when the internal eMMC storage density was doubled, from 32GB to 64GB. This still isn't a lot of space in the modern age for a system drive, but it's an improvement.

The second-gen unit has also retained the micro SD card slot with support for 128GB of SDXC v3.0 storage

with UHS-I support. All up, maximum storage is close to 200GB – not bad!

A visual check of the device reveals only one mUSB 3.0 port. However, the innovative design implemented has the USB 3.0 Type-C connection that provides power to the unit via a small power pack also providing a data link to two more USB 3.0 ports. This allows for mouse and keyboard to be plugged into this hub and leaving an unused USB 3.0 port on the Compute Stick for additional USB devices such as external storage options or additional peripherals.

The first-gen Compute Stick introduced a solid idea but required further refinement. This is the Stick you want.

Verdict

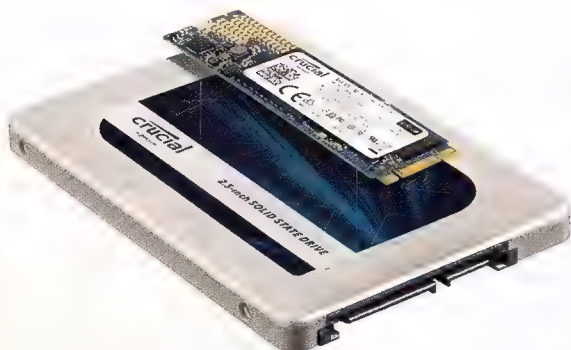
The Compute Stick comes of age in its second-generation iteration – bravo!





Instant performance that lasts.

Increase the speed, durability, and efficiency of your system for years to come with the Crucial® MX300 SSD. Boot up in seconds and fly through the most demanding applications with an SSD that fuses the latest 3D NAND flash technology with the proven success of previous MX-series SSDs. Your storage drive isn't just a container, it's the engine that loads and saves everything you do and use. Get more out of your computer by boosting nearly every aspect of performance.

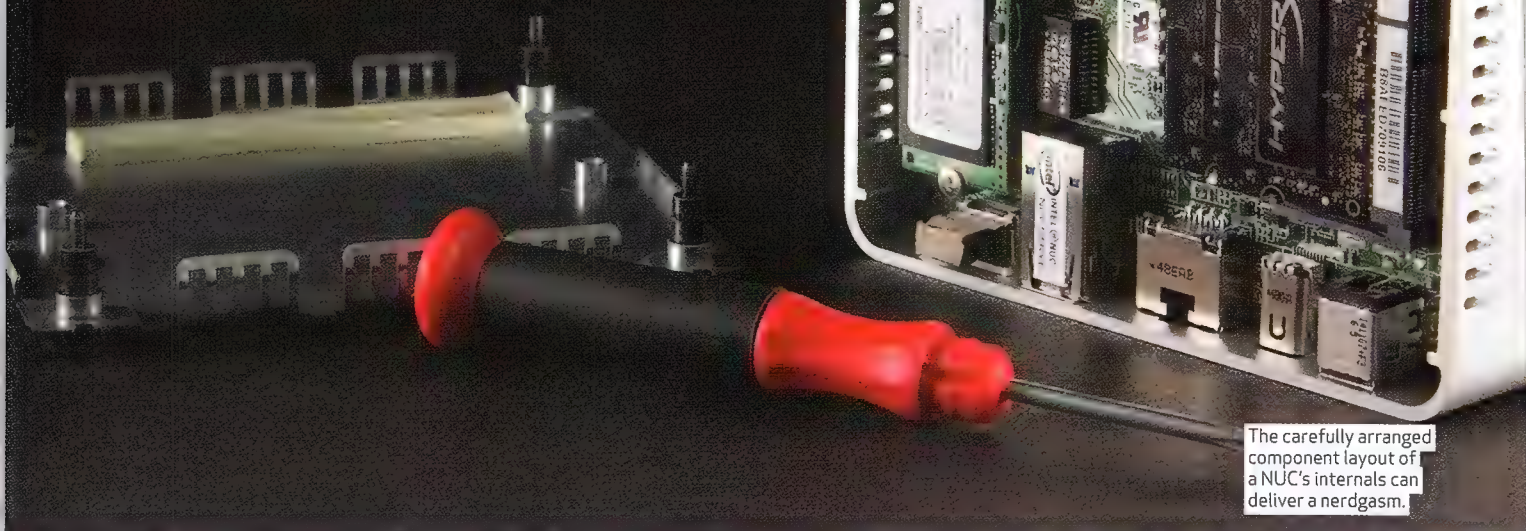


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Mini-PC projects

Josh Collins explains how you can do more in a smaller footprint with these fun and interesting projects for NUCs and stick PCs.



The carefully arranged component layout of a NUC's internals can deliver a nerdgasm.

Following on from our NUC and NUC-like mini-PC reviews story, we thought it'd be neat to look more broadly at the different usage models and the user experience of these little machines, via a handful of practical projects. In some cases, we've recommended specific hardware for certain applications, as in many of these projects specific features and attributes can benefit the user experience.

If you haven't yet read the review roundup, this shouldn't have too much of an impact on comprehending what's being discussed in this mini-PC projects feature. But of course, if you know the lowdown on which models are hot, what's not and, most importantly, why, then you're going to get much more out of reading this piece. Also worth noting is that these projects aren't complete step-by-step guides – they're intended to give you the ability to consider (with or without our guidance) what is a suitable mini-PC for a suitable usage scenario.

Lucky for you, these printed words aren't going anywhere, so if you wish to backtrack a few pages and checkout the roundup – go for it, we won't ever know. If you're keen to jump in the deep end and learn about different

usage scenarios for these diminutive computers, this is the piece for you. Well, then, let's get to it.

Starting with the obvious, let's quickly recap some details about the form factor. If you'd like a little more background, check out the introduction to the aforementioned group review roundup (on page 38).

The Intel Next Unit of Computing, aka NUC, is a moniker termed by Intel and describes a PC that conforms to the Ultra Compact Form Factor (UCFF). This attribute is predominantly due to the fact the NUC is based on a 10cm x 10cm motherboard. That tiny size means that most functional components will actually be clipped into or soldered onto the motherboard, with the general exception of 2.5-inch or 3.5-inch storage options typically secured within the unit's chassis and tethered by power and data cables. Beyond that, the system's RAM, CPU and other core components like M.2 SSDs (both SATA and NVMe protocols), eMMC storage options, wireless NICs in M.2 or mSATA slots, and so on, all potentially connect directly to the miniature motherboard through a range of interfaces.

NUCs are about applied usage and, while we've mentioned numerous types of core components that can

potentially be integrated into a NUC solution, the fact is these mini-PCs are typically designed with focused intention, rather than the broad shot, "this PC can do anything" type of approach associated with traditional, much larger form factor enthusiast DIY PCs.

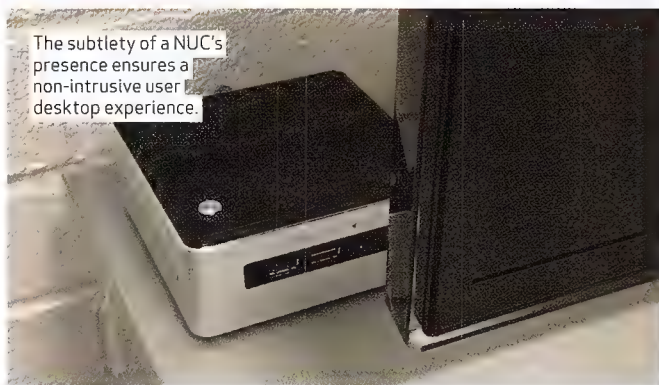
Before we look at specific scenarios, it is important to consider the task at hand, the computing requirements for this task and an appropriate solution. The range of potential hardware configurations, sizes, shapes and even aesthetic appeal vary widely now due to a healthy number of years delivering positive growth in user uptake as well as evolving technology allowing for more niche applications and unique implementations.

Key attributes of these mini-PCs are typically associated with size, storage solutions, processing capability and qualifications for a given scenario.

To put this into perspective, let's quick fire some concepts. For example, if you're after a mini-PC for a networked thin client for a publicly used terminal, you won't be selecting a unit with the fastest Core i7 processor paired with NVMe PCIe x4 SSD storage, as these resources would be wasted and would combine to present excessive and wasteful costs for the



A VESA-mounted NUC ready to play hide and go NUC with its owner.



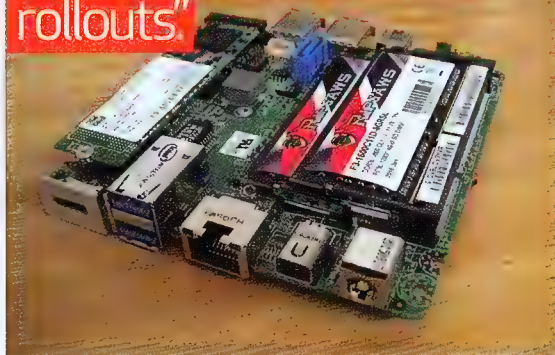
The subtlety of a NUC's presence ensures a non-intrusive user desktop experience.

implementation. Conversely, a mini-PC home server will require increased attributes in areas such as storage density and network connectivity, yet graphics processing power will be insignificant in its applied usage. Essentially, it's about ensuring you're not trying to plug a large square peg in a small round hole.

Many of these mini-PC options can appear very similar on the surface and yet have unique attributes not readily apparent from a casual view. For example, look at the NUC5PGYH and NUC5PPYH in the aforementioned roundup. These units look identical based on external physicality, have extremely similar model numbers, yet even with the same core spec of I/O, CPU and iGPU, just the inclusion of an integrated 32GB eMMC option in the NUC5PGYH opens it to some usage scenarios that perhaps the NUC5PPYH would either not be suitable for or result in incurring too high a cost for rollout. Therefore understanding what features are packed into what units is important, just as is properly assessing the application of these features to a given usage. Or, you may even choose the path of a DIY NUC — yes, that's a thing too.

In the coming pages, we will explore the computing fun that can be had by PC enthusiast weekend warriors as well as cover some aspects that could be of interest to ITC professionals. The aim of this piece is to provide a broad overview and where relevant provide examples of the versatility of the Next Unit of Computing.

"NUC internals can be bought as separate kits for DIY projects, perfect for custom digital signage and information kiosk rollouts"



What about professional usage scenarios?

NUCs and mini-PCs have stormed into the professional market

Intel's Next Unit of Computing has proven to be extremely versatile and adaptive to the needs and wants of professionals, ranging from small office outfits to large corporate rollouts and across a range of usages scenarios and business types.

The small size, range of price points and related computational ability backed by Intel actively adapting to the needs and wants of the professional market, there is seemingly a NUC for every conceived scenario. And if a new segment is found or created, you can almost be certain a NUC or NUC-like product will be created to fulfil the needs and wants.

Professional implementations can vary considerably. Some examples of professional usage scenarios are:

- Digital signage
- Information kiosks
- Networked thin client
- Corporate meeting rooms
- Digital conferencing
- Commercial productivity
- Video surveillance

The scalability of implementation is an important aspect, but so too is the ability to reduce restrictions within a business' ITC infrastructure and rollout. Intel hosts online information regarding numerous NUC rollout case studies and in some scenarios the gains for the business are significant. WAND Corporation, a digital signage company servicing the fast food industry in North America has stated that simply by rolling out NUCs to facilitate digital signage, removing the need for staff to change signage as menus change throughout the day resulted in a very significant 12% operational efficiency increase — impressive!

Check out more here: intel.ly/1m6VgqF



An ASUS VivoMini-V VC65R makes for a potentially super-stacked file server.

Home Mini Server Potential Spec

The ASUS VivoMini-V VC65R is available in a spec that provides four 2.5-inch storage bays, the VC65R-G002M, complete with RAID support. Here are two spec ideas:

For approximately \$1,850, you get the VC65R-G002M, four WD WD40E31X 4TB 2.5-inch SSHD and 8GB (2 x 4GB) of DRAM. This delivers a 16TB mini server ready to go.

Alternatively, for approximately \$2,250 you get the VC65R-G002M, four Seagate ST5000LM000 5TB 2.5-inch HDD and 8GB (2 x 4GB) of DRAM. This delivers a 20TB mini server in a chassis with a volume of 2.34L — small footprint, big density!

Project idea #1: Mini home server

SMALL FOOTPRINT, BIG DENSITY.

With an ever-digital life requiring dense storage solutions to keep up with our content creation and content consumption, having one's digital life centrally served can make life so much simpler. This assessment is relevant to serving digital media collections for movies, music and TV shows, through to storing digital memories and documents such as family photos, important personal documents and so on, or perhaps to assist not just in creating order from the chaos of sizeable quantities of digital content but also create order from the chaos of numerous digital devices.

Depending on a number of factors, you may even consider utilising multiple services from a home mini server. For example, you may wish to set up a proper domain network structure operating from a central

server to provide services such as DHCP or firewall protection if you wish to offload these from typically being implemented by a modem-router or router. Or perhaps you may take a 'dumb server' approach and rather than making the system a server as per the traditional sense, it could simply be another client PC on the network but with the storage drives mapped to the network and shared to other network clients.

You can go the vanilla route and look into different operating system versions, possible usage restrictions, within the Windows ecosystem, but there are so many great and often free alternative home server OS options out there to consider. There are options that are both noob friendly and hardcore to deliver the level of functionality, granular control and

user friendliness that you require for your needs.

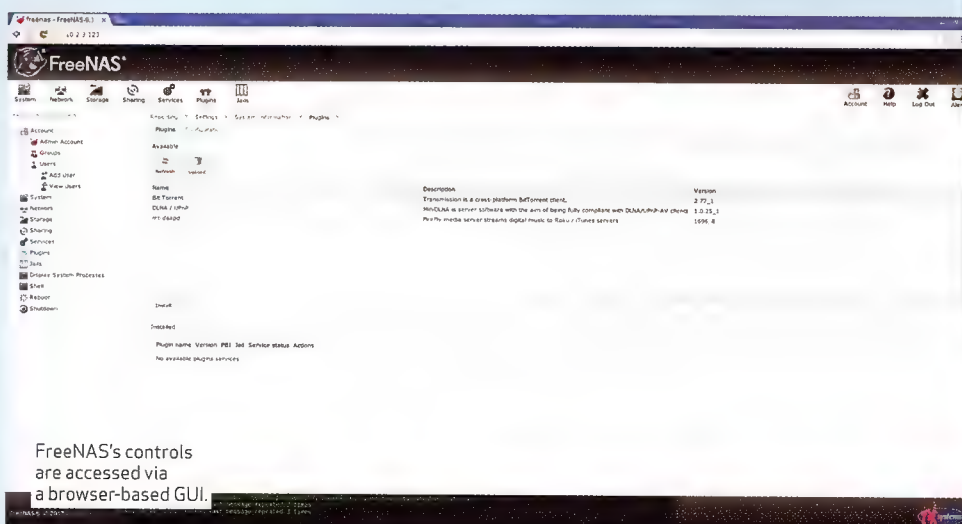
Some alternative server operating systems for home use include Amahi Home Server, FreeNAS, Open Media Vault, XPenology, NAS4Free and for the console line Linux champions there's Ubuntu Server.

While serving data is a core functionality of a home mini server, another useful function is to operate as a centralised backup point for other client devices on the network. So you may consider configuring the client to back up data to the home mini server on a daily basis or perhaps just once a week, or month, depending on the importance of your data.

Free operating systems to consider

Sure, a Windows-based OS is an option, but why not consider a free, specialised solution for your needs? Consider checking out the following:

- Amahi Home Server
- FreeNAS
- Open Media Vault
- XPenology
- NAS4Free
- Ubuntu Server (command line-based for the advanced users)



FreeNAS's controls are accessed via a browser-based GUI.

Project idea #2: Carputer

A CUSTOM CARPUTER CAN POTENTIALLY RUN CIRCLES AROUND A STOCK CAR ENTERTAINMENT SYSTEM.

The 'carputer' isn't a new concept. PC enthusiasts have actually been finding ways to shoehorn PCs into cars for over 15 years and as technology has emerged and/or improved, backed by passionate forum communities, the carputer enthusiasts ultimately made their own market driven by their passion.

A carputer can deliver increased functionality and not only be a fun project but also provide improved features and functionalities of the vehicle, thereby improving your driving experience. Such examples of improved capability include the availability of real-time vehicle diagnostics and increased digital media library size, functionality, management and presentation within the context of a motor vehicle. A carputer can also provide increased vehicle security with unauthorised vehicle entry detection, linked external cameras and integrated recording devices.

In the early days of carputer adoption and implementation, two of the biggest issues were moving parts – particularly spinning disk drives – and excess heat generation and dissipation. Furthermore, the carputer can go through some difficult environmental conditions considering aspects such as prolonged and direct sunlight exposure if in an open area of the vehicle, significant hot and cold temperature variation and fluctuating humidity.

Thankfully, with today's PC tech driven by mobile development and implementation, elements of concern such as low power usage and improved power state management have almost completely disappeared as a concern. Add to this the prevalence and relatively cheap cost of flash storage options, thereby eliminating mechanical parts and significantly increasing reliability in what can be a tough environment for electronics – this is all good news for DIY carputer implementation.

A major aspect of consideration outside of the operational environment and hardware suitability is supplying sufficient clean power to the system. While inverters are an option, the inefficient process of DC-AC-DC power conversions can create excessive heat and interference. A better approach is to use a broad spectrum DC-DC converter to create 3.3v, 5v and 12v rails for the PC to utilise. Due to the broad spectrum power frequency support, the converter should help remove peaks and troughs in power supply to the PC and therefore avoid power drops or spikes that may result in either a reset PC or in worst cases scenario, damaged components.



A custom carputer implementation, complete with custom dash integration.

NVMe Public Service Announcement!

If you're looking to implement a high speed NVMe PCIe x4 SSD into your mini-PC for blistering fast SSD storage be sure to check you're getting all of the performance you have paid for.

One detail that Windows 10 has nailed to make life easier for the average user is the inclusion of a broad array of functional box drivers. For those not in the lingo-loop, a box driver is the default driver utilised by the operating system and is typically quite generic to encourage compatibility and stability.

In the case of the Windows 10 NVMe box driver, as NVMe drives have proliferated in the market and subsequent Win10 OS builds are rolled out, the NVMe support has improved significantly since the launch of the technology. Transfer speeds based on the box driver get close to optimum transfer but a vendor specific driver can still unlock more. Given you've paid the premium for NVMe storage, don't let performance be lost by something as simple as installing the driver. Examples in the table below are from this issue's roundup labs testing.

MAKE SURE TO GET ALL OF THE PERFORMANCE YOU PAID FOR.				
	INTEL SKULL CANYON NUC (NUC617KYK) WITH SAMSUNG 950 PRO		ASUS VIVOMINI-U UN65U WITH SAMSUNG EVO 960	
CRYSTALDISKMARK 5	MICROSOFT NVME BOX DRIVER	SAMSUNG NVME DRIVER V2.1	MICROSOFT NVME BOX DRIVER	SAMSUNG NVME DRIVER V2.1
CRYSTALDISKMARK 5 - SEQUENTIAL Q32TI READ (MB/S)	2,029	2,241	1,843	1,866
CRYSTALDISKMARK 5 - 4K Q32TI READ (MB/S)	602.4	137	132.1	134
CRYSTALDISKMARK 5 - SEQUENTIAL READ (MB/S)	1,903	2,099	1,421	1,416
CRYSTALDISKMARK 5 - 4K READ (MB/S)	55.05	41.67	34.29	36.32
CRYSTALDISKMARK 5 - SEQUENTIAL Q32TI WRITE (MB/S)	951	952.5	1,397	1,362
CRYSTALDISKMARK 5 - 4K Q32TI WRITE (MB/S)	334.6	134.7	108.5	130
CRYSTALDISKMARK 5 - SEQUENTIAL WRITE (MB/S)	953	952.3	1205	1282
CRYSTALDISKMARK 5 - 4K WRITE (MB/S)	178.5	84.14	72.29	82.74

Project idea #3: Home-theatre PC (HTPC)

A MINI-PC'S INHERENT CALL TO ARMS.

Implementation as a home theatre PC (HTPC) is a core usage scenario of almost any NUC. The small size, typically subdued styling, quiet operation, energy efficiency and ability to be VESA mounted for an inconspicuous setup, all make for attractive attributes towards HTPC operation.

Obviously, the core functionality of the HTPC is media consumption, allowing for easy enjoyment of your digital entertainment content, both stored locally and streamed from online. One important consideration to make is the software you wish to use and the level of integrated functionality you want to achieve.

The simplest form of HTPC is essentially a desktop PC attached to a TV. This means complete with mouse and keyboard inputs and typical operating system functionality – likely Windows. Pairing the known desktop environment with decent media player software, for example, the ever-trusty VLC media player will get you enjoying content quickly. The downside is that the user experience will forever hark back to it's origins – the desktop.

If you're looking for something a bit more couch potato friendly, consider some front-end software solutions like Kodi or Plex. These software solutions provide intuitive GUI design and improved user experience with the option to extend further to facilitate media centralisation and potentially also serving to other devices on the network.

Many of the NUCs and NUC clones feature infrared receivers on the front

"Obviously, the core functionality of the HTPC is media consumption, allowing for easy enjoyment of your digital entertainment content, both stored locally and streamed from online."

of the unit. This is perfect for pairing with an IR remote control. The use of the IR remote will return the 'couch mode' feel of the HTPC setup and help to disguise its desktop origins.

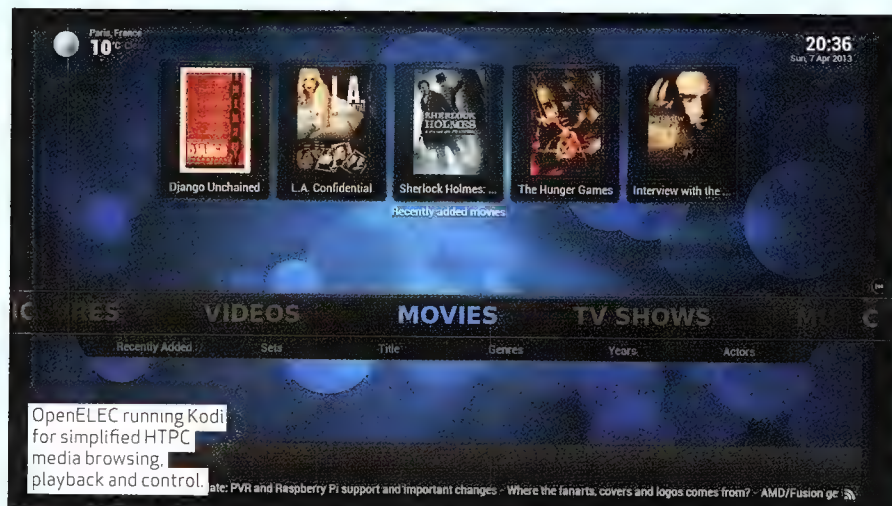
You can take this setup a step further by utilising a media centre focused, open-source (free), Linux-based operating system such as the Open Embedded Linux Entertainment Centre, better known as OpenELEC. This media centre OS has a pre-configured version of Kodi integrated and ready to look after your HTPC needs. Use a remote control rather than a keyboard and mouse for controlling your

OpenELEC + Kodi HTPC setup and you'll forget in no time that your home theatre is a PC.

When considering the hardware specification for this usage scenario, it's important to get a few foundations set from the get-go. For example, what type of media will you be playing? Are you just using 720p and 1080p media? Or do you enjoy Blu-ray content and perhaps even 4K content too? If so, you will need increased processing power to get the job done for the higher resolutions and bit rates. It's also worth being mindful of hardware optimisations? For example, Skylake processors have a hybrid software and hardware HVEC and VP9 processing method that was optimised with the latest Kaby Lake CPU releases to facilitate full hardware based 4K HVEC and VP9 processing support.

Utilising hardware processing wherever possible is a great way to reduce system overhead and thereby potentially allow for a lower spec on CPU requirements and improved memory availability.

This hardware-based solution reduces system overhead and in the case of the release of the optimised Kaby Lake microarchitecture, can also support DRM aspects of emerging high bit rate, high definition audio-video streaming services.



Project idea #4: Mini gaming PC

WHETHER LOCALLY RENDERED OR
STREAMED, THERE ARE EVEN NUCS
WITH GAMING ABILITIES.

When it comes to gaming chops and mini-PCs, there are a few ways of going about securing the right performance to deliver the desired user experience. Paired with awareness of what is and isn't asking too much of these diminutive PC solutions within the scope of gaming is important to consider in order to avoid some disappointment from the user experience and general implementation.

There are a few things you need to outline prior to even looking at specifications of different NUC-like mini-PC products on the market. These main questions are:

- What level of visual fidelity do you desire?
- What resolution will you want to output?
- Will the gaming processing be done locally on the mini-PC or on a dedicated gaming PC and streamed to the mini-PC's inputs and outputs?
- If processed locally, how much graphics processing power do you require?
- Will an integrated GPU (iGPU) be sufficient for your planned solution or will you require discrete GPU (dGPU) levels of performance?
- If implementing a dGPU option, how is it implemented into the build specification? Will you utilize a hybrid iGPU-dGPU loading solution for improved energy efficiency or will the dGPU be engaged as primary graphics processor and the iGPU completely disengaged?

Understanding these questions, the subsequent answer(s) and whether the

outcome is suitable for your intended goal is key to avoid a half-baked implementation that does the job but comes short of the desired experience.

Looking specifically at three examples from the NUC-like mini-PC roundup, the ASUS VivoMini-V VM65N, Intel Skull Canyon NUC (NUC6i7KYK) and Gigabyte Brix Gaming UHD GB-BNi7HG4-950-MF, these three options present different levels of gaming competence and with it system presence within the home theatre.

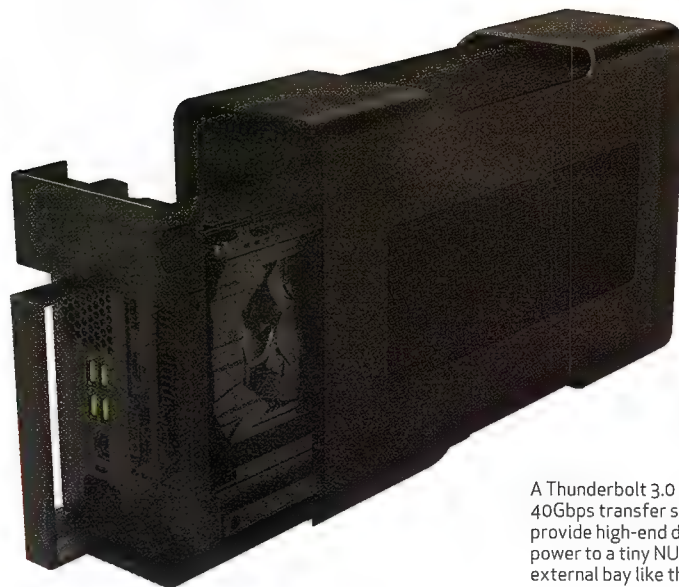
The VM65N represents the use of mobile hybrid GPU technology as the unit automatically switches between the Intel HD Graphics 520 iGPU and the mobile tech derived GeForce 930M dGPU depending on graphical workload requiring processing. While the GeForce 930M would be considered by mainstream core PC gamers to be insignificant compared to their high-end desktop counterparts, but in these small form factor solutions the use of the GeForce 930M considerably boosts graphics processing power compared to the iGPU alternatives. A clear example of this is the almost doubling of 3DMark results when comparing the VM65N and VC65R benchmark results from the review roundup. Interestingly, you can see the gap close considerably between Fire Strike and Ice Storm Extreme results

due to the simplified visual effects in Ice Storm Extreme compared with the comparatively brutal Fire Strike benchmark.

The Skull Canyon NUC demonstrates the potential pixel pushing power of a high-end Intel iGPU utilising the Intel Iris Pro Graphics 580 core. This unit is sufficient for many eSports titles such as *Counter Strike: Global Offensive*, *League of Legends* and *DOTA2*. Packaged in the sleek, slender chassis and with plenty of connectivity for controllers, this could be a great console replacement PC for the home theatre.

The Brix Gaming UHD unit introduces a low-end discrete desktop GPU to the mix. This spec inclusion romps over every other mini-PC in the review roundup. This is thanks to the GeForce GTX 950 GPU and will help facilitate mid-graphics levels at 1080p resolution.

The need for a strong discrete GPU can be negated by utilising a networked dedicated gaming machine to do the majority of the gaming processing, then streaming over the network to the mini-PC with gaming software solutions like Steam. For best outcomes, ensure the mini-PC has plenty of CPU power and RAM, running on a Gigabit Ethernet connection — preferably wired to reduce latency. ■



A Thunderbolt 3.0 port with a 40Gbps transfer speed can provide high-end desktop GPU power to a tiny NUC PC, via an external bay like the Razer Core.

Mini gaming PC in one hand,
controller in the other —
watch out lounge room!



Cloud-connected security cameras

Make your own home security monitor or nanny cam with a networked camera and Nathan Taylor.



Proper, professionally installed home security systems are an expensive proposition. It's not just the initial installation cost – there's the ongoing cost of managing and monitoring the feeds.

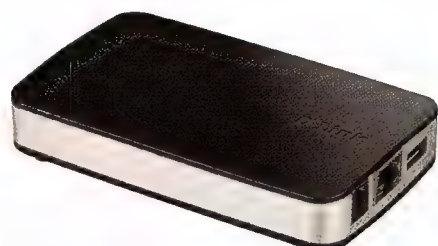
It is possible – and actually relatively easy – to create your own home security system using inexpensive IP cameras. We're talking motorised camera with motion-detection alerts, tampering alerts, recording and image capture based

on events and much more. IP cameras can also be used as very effective nanny cams and pet cams, keeping an eye on your loved ones even when you're away from the house.

If you're interested in setting up your own home camera security system or nanny cam, the place to start is finding the right model of IP camera for you. This month, we'll take a look at some of the models available.

IP CAMERA SPECIFICATIONS

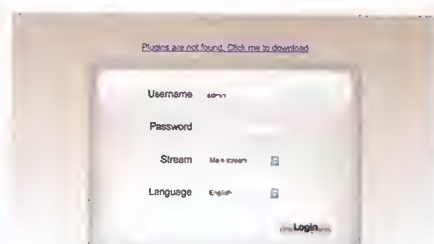
PRODUCT	BELKIN NET-CAM HD	D-LINK DCS-2630L	D-LINK DCS-936L	FOSCAM F1983IP	SWANNCLOUD ADS-446	SWANNCLOUD ADS-456	TP-LINK NC250	TP-LINK NC450	UNIDEN GUARDIAN APP CAM 26
VENDOR	BELKIN	D-LINK	D-LINK	FOSCAM	SWANN	SWANN	TP-LINK	TP-LINK	UNIDEN
WEBSITE	BELKIN.COM.AU	DLINK.COM.AU	DLINK.COM.AU	FOSCAM.COM/AU	WWW.SWANN.COM/AU	WWW.SWANN.COM/AU	WWW.TP-LINK.COM.AU	WWW.TP-LINK.COM.AU	WWW.UNIDEN.COM.AU
STREET PRICE	\$130	\$450	\$160	\$160	\$150	\$160	\$90	\$150	\$200
MAX RESOLUTION	1280 X 720, 25FPS	1920 X 1080, 30FPS	1280 X 720, 30FPS	1280 X 960, 30FPS	1280 X 720, 30FPS	1280 X 720, 30FPS	1280 X 720, 30FPS	1280 X 720, 30FPS	1280 X 720, 30FPS
HORIZONTAL FIELD OF VIEW	79 DEGREES	180 DEGREES	120 DEGREES	80 DEGREES	UNSPECIFIED	UNSPECIFIED	64 DEGREES	75 DEGREES	UNSPECIFIED
MOTORISED PAN AND TILT	NO	NO	NO	300 DEGREE PAN, 120 DEGREE TILT	350 DEGREE PAN, 100 DEGREE TILT	NO	NO	300 DEGREE PAN, 110 DEGREE TILT	270 DEGREE PAN, 110 DEGREE TILT
ACTIVE (IR) NIGHT VISION	YES (UNSPECIFIED RANGE)	YES, 5M	YES, 5M	YES, 8M	YES, 5M	YES, 5M	YES, 5M	YES, 8M	YES (UNSPECIFIED RANGE)
MICROPHONE	YES	YES	YES	YES	YES	YES	YES	YES	YES
SPEAKER FOR 2-WAY AUDIO	NO	YES	NO	YES	NO	NO	NO	YES	YES
WIRED NETWORKING	NO	NO	NO	YES	YES	YES	YES	YES	YES
WIRELESS	802.11B/G/N	802.11AC	802.11B/G/N	802.11B/G/N	802.11B/G/N	802.11B/G/N	802.11B/G/N	802.11B/G/N	802.11B/G/N
LOCAL STORAGE	NO	MICROSD CARD SLOT	MICROSD CARD SLOT	MICROSD CARD SLOT	MICROSD CARD SLOT	MICROSD CARD SLOT	NO	SD CARD CLOT	MICROSD CARD SLOT



D-Link's DNR-202L, a consumer network video recorder (NVR). It can continuously record and store streams from up to four IP cameras, storing the video on USB hard drives.



iSpy is an open-source application for capturing IP camera streams on your PC.



It is absolutely essential that you change the default password on your camera.

How you use IP cameras

If you've never owned an IP camera before, you may not be familiar with how they work. So here's a quick primer on consumer IP cameras:

- An IP camera connects to your home network, rather than your PC. You either plug an Ethernet cable in and connect it to your router (for those cameras that have Ethernet), or you configure it to talk to your Wi-Fi network. To set up the latter, the camera typically creates its own hotspot on first setup — connect to that to talk to the camera, then tell the camera to talk to your main Wi-Fi network. Alternatively, some wireless cameras can be set up by showing them QR codes.
- Broadly speaking, there are two kinds of cameras: fixed and motorised. The latter includes a motor that lets you remotely control the direction the camera is facing.
- The IP camera has its own internal web server. If you visit its IP address in a web browser, you'll be able to see the live feed from the camera as well as adjust the settings. More commonly, you'll actually use a mobile or desktop app to access the feed and control it.
- Cameras usually don't come with any internal storage for recording the feed, though many allow you to insert a memory card. It won't record every moment (that would fill a memory card very quickly), instead you'll typically configure recording or still-image capture based on events like motion detection, camera tampering or facial recognition. For example, if it detects someone at your door, it can be set to take a photo of them or record 15 seconds of video and send you an email notification with the attached grab.

You can also use a PC, network video recorder (NVR) appliance or NAS (network attached storage) to grab and record streams. NAS boxes from QNAP, Synology, Asustor, Seagate and Thecus all come with 'surveillance manager' apps that can monitor and capture streams from multiple IP cameras. There are many desktop PC apps that will do the same.

- Nearly every consumer IP camera also talks to a cloud service. This cloud service lets you tunnel through your router's firewall, letting you view the stream from anywhere. In some cases, the cloud service will also offer online storage for captured clips and images.
- Most cameras now also have active night vision — IR emitters that can create a monochrome image of a room even if the room is totally dark. The range of the night vision is usually 5m or so, but some cameras can go better.



\$130 | WWW.BELKIN.COM/AU

Belkin NetCam HD

A camera built for home automation.

About as vanilla as IP cameras get, the NetCam HD offers a just-the-basics HD solution, with its prime virtue being its integration with Belkin's WeMo home automation products.

It does offer a relatively seamless consumer experience, with nicely tuned mobile software and a web interface that's easy to use. We had no issues setting it up with only the mobile app. It doesn't have local storage — if you're willing to subscribe to Belkin's Cloud+ services (the camera comes with one month free), it will upload recorded clips and captured images to the cloud.

There were shortcomings, however. In particular, the limited sensitivity and movement detection options would often result in way too many notifications, to the point where you'd likely just start ignoring them.

The hardware is also limited. There's no wired option, and the design of the camera limits your

positioning and facing options. It's designed to sit on a shelf, with the camera rotating around a post for positioning.

The sensor is capable of 720p recording at 25fps, with the option to take 2MP stills. We found the quality of the image okay — colours were a little washed, and the night vision a little blurry — but it's good enough for most security applications.

With the aforementioned WeMo home automation system, you can use triggers from the camera to control other WeMo-connected appliances, like turning a light or appliance on. It's a nice system, letting people set up simple home automation systems without great expense or required expertise.

Verdict

Decent enough if you're using other WeMo devices, but there are better options if you're not.





\$450 | WWW.DLINK.COM.AU

D-Link DCS-2630L

Going super-wide angle.

A very cool-looking 'eyeball' camera, D-Link's DCS-2630L takes a different approach to covering a room. Instead of using motorised pan and tilt, D-Link put an extremely wide-angle lens into the camera, covering a full 180° with a single 1080p stream. This naturally results in a significant fish-eye effect, and even though the camera tries to de-warp the image, you still get images that are compressed at the edges and expanded in the middle.

The advantage of this over a motorised system is clear: you always have full coverage of the room without having to redirect the camera, which makes the camera much harder to dodge. On the other hand, you won't get good stills of your kids' playing.

We love the physical design of the camera, and with the flexible post and rotating camera ball you have the option to mount it

on a shelf, wall, or ceiling. It has a two-way speaker built in (so you can talk to the people you're watching, even remotely) and is the only camera reviewed here that supports both 1080p and 802.11ac wireless.

The software and web interface is also very good, with fine notification and motion sensitivity options and the capacity to 'black out' parts of the image from motion detection. It could use a little sprucing up in the design department, but functionally it's excellent.

But it comes with an excessive price tag. You're paying a huge premium for Full HD, costing three times as much as most of the others reviewed here. It's a very good camera, but not three times as good.

Verdict

It's an excellent camera for security, but that price tag is way over the top.



\$160 | WWW.DLINK.COM.AU

D-Link DCS-936L

For those looking for something discreet.

A much more affordable camera than the DCS-2630L, the DCS-936L is built for people looking for something much simpler. It's a great little camera, compact and capable, and using D-Link's solid and non-technical cloud service and mobile apps for control.

Its hockey-puck design is great for shelf or ceiling mounting, with the camera lens flipping up from and rotating around a circular base. It can also be wall mounted, but you might find it a little frustrating to angle the camera just right.

We found the image quality to be perfectly solid when we tested it. Because it has a very wide angle lens (though not as wide as the DCS-2630L), it does have a notable amount of fish-eye distortion, but that tends to be the cost of capturing a larger part of a room at once.

We're also fans of D-Link mobile software and web interface. It's very easy to set up and intuitive to use,

but still covers some of the more advanced features well, like fine-tuning motion detection notifications and recordings (pinch-to-zoom on mobiles is also really neat). You can configure it to record locally to a microSD card, and snaps can be sent to your mobile.

There's one final little touch that we love as well: the Wi-Fi signal locator. It's a visual indicator of Wi-Fi reception, making it easier to position the camera in a spot where it gets good enough Wi-Fi signals.

Verdict

A capable, wide-angle camera with a good software package.





\$160 | FOSCAM.COM/AU

Foscam FI9831P

Feature packed and affordable.

For its modest price, the Foscam FI9831P has excellent specifications, including the ability to capture and stream video at 1,280 x 960. It has motorised pan and tilt, two-way audio, SD-card storage and long-range night vision that was our pick for best night-vision reception.

The software interface left us a bit cold, though – it doesn't have the consumer friendly polish of some of the competition. But it has excellent options for motion detection and capture, colour adjustment and local recording and capture. It can upload captured images to FTP servers or send them via email, and you can set up multiple users with different access rights. The mobile viewer apps are more user-friendly, but they don't let you do much other than view feeds and perform the most basic wireless configuration.

Foscam also supplies a free Windows app for

capturing and recording streams as well as a free DDNS service that makes it possible to access the web interface remotely, though you need some technical know-how to set that up. If you want remote access to your feeds, you'll need to subscribe to Foscam's paid Cloud Service.

If you're comfortable with the technical stuff, or plan on using third-party software to control the camera, the Foscam is great value. Its night vision is great, its general image capture is good (though we thought the compression a little too high, resulting in some blurring and blockiness) and its hardware specs are better than most of the other cameras here.

Verdict

Excellent value for the hardware on offer, but the software solution veers on the technical side.



\$150 | WWW.SWANN.COM/AU

SwannCloud ADS-446

A pan and tilt with excellent image quality.

Although it technically has a higher recommended retail price than the ADS-456, when checking street prices we actually found the ADS-446 was available at prices lower than that of the 456 – which is a bargain, because the 446 is the better camera in every way.

It has a pan and tilt motor, but that's just the beginning of the good stuff when it comes to the ADS-446's hardware. There's also a removable/swappable Wi-Fi antenna; an I/O block for attaching external alarms and sensors; a mini-HDMI port that outputs the current feed and an actual, proper wall and ceiling mounting bracket included in the box.

The hardware is coupled with Swann's very good software and firmware. The mobile apps allow you to view feeds – including remote feeds linked to the free SwannCloud service – and perform

basic setup of the camera. If you want finer control over things, like motion detection sensitivity, motion detection blocking and event triggers, notifications and recordings (which can be stored on a microSD card), you'll need to log into the more complex web interface. It's technical to use, but it gives you a lot of excellent options.

The image quality we found was excellent: not over-compressed as some cameras do, but clear and with good colour fidelity. Night vision was also top-shelf. Given this, the quality of the hardware and the convenience of the SwannCloud remote access service, this camera gets top marks from us.

Verdict

Great image quality and solid software.





\$155 | WWW.SWANN.COM/AU

SwannCloud ADS-456

A fixed position camera with some unique touches.

The ADS-456 boasts a lot of the same virtues as the ADS-446, including excellent image quality and night vision, useful first-party software and a neat hardware design. That hardware includes some unique touches, like the mini-HDMI port that can be used to view the current feed on a TV screen, a microSD card slot and a proper mounting bracket for attaching the ADS-456 to a wall or ceiling.

Physically, the design of the ADS-456 is similar to that of the Belkin NetCam – a fixed 'cube' rotating around a post. The main body of the camera can tilt up to 90°, which should cover most angles with some proper planning. It does look a little ugly in a wall-mount situation, however, since it protrudes a long way from the wall.

It uses the same underlying software and firmware as the ADS-446, which is a good thing, since it's generally a solid

solution, with easy-to-use mobile apps for beginners and a more technical web interface for those who really want to drill down into the notification and motion and facial detection settings.

It also includes free access to SwannCloud, a service that works a lot like MyDlink – register a camera with the cloud service and you'll be able to view its feed from anywhere on the 'net using the Swann mobile app. There is a paid version of SwannCloud that also includes online storage of event feeds, images and clips, but that's optional.

It's a very nice camera overall, and we'd recommend it if the ADS-446 weren't both better and available for less.

Verdict

A very solid all-round fixed position camera.



\$90 | WWW.TP-LINK.COM/AU

TP-Link NC250

HD for cheaps.

If you just want something that's cheap and gets the job done, the TP-Link NC250 is the order of the day. It's about as basic as IP cameras come, but for less than \$100 you'll get a perfectly capable 720p IP camera that's easy to set up and has a feed that can be viewed from anywhere.

The primary means of viewing the feed is the mobile app: the much-improved tpCamera, which is useful for initial setup, viewing and locally (on the mobile) capturing live feeds. For a deeper dive into the configuration options, you have to log into the web interface. That interface is well organised and approachable, but it's short of the options provided by the likes of Swann and Foscam.

It does provide one unique option – the wireless extender. The NC250 can function as a wireless repeater in addition to its camera functions, extending the range of your

wireless network. It's probably not something we recommend, but if you're going that route, it might save you some money.

Like most consumer IP cameras, the NC250 links to a cloud service, allowing you to view the live feed from anywhere after registering your camera.

When it comes to image quality, we found the compression a bit much, making images a little fuzzy, but the colour definition and capture is excellent, and the well-balanced night vision mode shows easily recognisable faces and decent definition. It should be good enough for most users, and you can't complain when an HD camera is this affordable!

Verdict

An OK camera at a very low price.





\$150 | WWW.TP-LINK.COM.AU

TP-Link NC450

An affordable new pan and tilt.

The new NC450 has added affordable motorised pan and tilt to TP-Links roster, although some of the shortcomings of the software we identified in the NC250 review are still present here.

Let's start with the good stuff: the hardware. A smooth pan and tilt engine can point the lens through a wide range of positions and the base is well designed for mounting on any surface. There's an SD Card slot for local storage, night vision that extends to 8m (3m more than most) and a two-way audio system that lets you talk through the camera, so you can communicate with your kids as you watch them.

The camera captured some very good images, too. Not quite up there with the Swann cameras (thanks to what we think is a little too much compression), but definitely good enough for most applications. The night vision capture was perfectly solid as well,

with the camera quickly adjusting to a good saturation.

But the software is a little off. We like the design of the web interface – it's logical and well ordered, providing easy access to common options – but some of the features found in other cameras just aren't there. The mobile app is useful mostly for setup, live streaming and two-way chat. It does support local capture and recording on the mobile, but event management and configuration is pretty much left out.

Aside from some mostly minor quibbles with the software, we think this is a pretty nice camera, available at an affordable price.

Verdict

An elegant (and very cute) pan and tilt camera, with good hardware and sensors.



\$200 | WWW.UNIDEN.COM.AU

Uniden Guardian App Cam 26

Is it worth the price premium?

Originally released back in 2014, the Guardian App Cam 26 is starting to show its age. The hardware is still passable, delivering HD recording with solid image quality and a neat two-way speaker, but the software shows its rough edges with a poorly designed interface in rather heavy need of upgrading.

Although its interface may need an overhaul, there were some things we definitely liked about the software. The mobile apps provide more power to customise and control the cameras event and recording settings than most comparable apps. With a lot of the competition, the apps are there mostly for viewing feeds and events, while the web interface did the heavy lifting of configuration. Uniden's mobile app gives you more control over the settings than most, without needing to open a browser, though to get right down to the gritty

stuff you still will need to access the (somewhat intimidating) web interface. And integral cloud service lets you view feeds on your mobile from anywhere.

The quality of the live stream was okay when we tested, and the same can be said of the night vision. Faces were recognisable (it's still HD after all), and colour and saturation balance was good in both night and day modes, but there was notable compression loss.

Although it was a good product when it came out, the Guardian App Cam 26 is merely an average one today, failing to justify the price premium over the competition. It's not a bad product by any means, but you can do better.

Verdict

You can do better.

100 tips and tricks for Windows 10

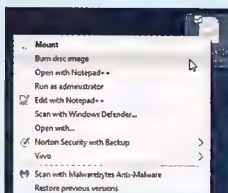
The APC team reveals its top 100 essential hints, tips and secrets for getting more out of Windows 10.

You may have been using Windows for years, or you may be a newcomer to the PC, but either way, there's always something new to learn, and for more seasoned users, there are plenty of hidden tricks that will make your day-to-day computing life that bit easier. Whichever camp you fall into, we've unearthed 100 great ways of improving Windows — they're written for Windows 10, but many work with earlier versions of Windows, too.

There are many impressive tools and options built into Windows. Some of these are obvious and easy to discover, but there are numerous other secrets that you can reveal just by scratching beneath the surface of your Windows OS.

Over the coming pages, we'll share some of the best Windows advice. Our top 100 tips include basic hints to make life easier, such as changing the order of your Taskbar, or locking your computer with a simple key press, to more under-the-hood tasks, such as clearing up free space or creating an emergency boot disk.

So kick up your feet and read on for a wealth of information about Windows.



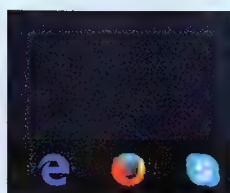
1 BURN ISO DISC IMAGES

Just right-click an ISO file and select the 'Burn disc image' option. Select the disc burner you'd like to use, insert a blank disc and click the Burn button.



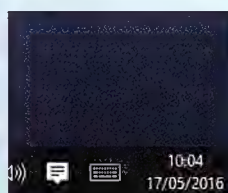
2 RE-ORDER THE TASKBAR

Inject a little order into the Taskbar by rearranging its icons. Just click and drag an icon to its new place — you'll see the other icons move along to make way.



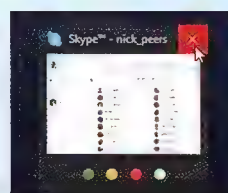
3 QUICKLY LAUNCH TASKBAR APPS

You don't need to use the mouse to launch programs that have shortcuts in the Taskbar. Press 'Win-1' to launch the first icon on the Taskbar and so on.



4 QUICKLY CHECK THE DESKTOP

No need to minimise all your open windows to view the desktop — just move the mouse to the lower right-hand corner of the screen, and they temporarily vanish!



5 CLOSE APPS WITHOUT SWITCHING TO THEM

Hover the mouse cursor over a Taskbar button, and click the red cross located on the preview to close it completely.

6 RUN TWO PROGRAMS SIDE BY SIDE

Don't bother manually resizing program windows — just drag a window to the left side of the screen and it expands to fill half of it. Repeat with another window to the right to see both side by side. Windows can be un-docked by dragging them out of position again.

7 USE PINNED FOLDERS FOR FAST ACCESS

If you use the same folders often, pinned folders come in handy. To pin a folder to Windows Explorer's jump list, open File Explorer, then drag a folder into the Quick Access list — not only will it be visible from here, but when you right-click the File Explorer Taskbar icon, you'll find the pinned folder is there, too.

9 LAUNCH A NEW PROGRAM WINDOW

When a program is running and you click its Taskbar icon, you switch to that app. If you would prefer to launch a new window, just hold down the Shift key as you click the icon.

10 GAIN MORE DESKTOP SPACE

The Taskbar is useful, but you may not need it displayed at all times. To maximise the size of your desktop, right-click an empty section of the Taskbar, and select 'Properties'. On the Taskbar tab, check the box labeled 'Auto-hide the Taskbar' and click OK. The Taskbar disappears until you move your mouse to the very bottom of the screen — it then slides into view.

11 MOVE BETWEEN YOUR MONITORS

If you've got more than one monitor connected to your computer, you can avoid having to drag and drop windows between screens by simply pressing the keyboard combo 'Win-Shift' along with the left or right arrow keys.

12 TASK SWITCHING AND VIRTUAL DESKTOPS

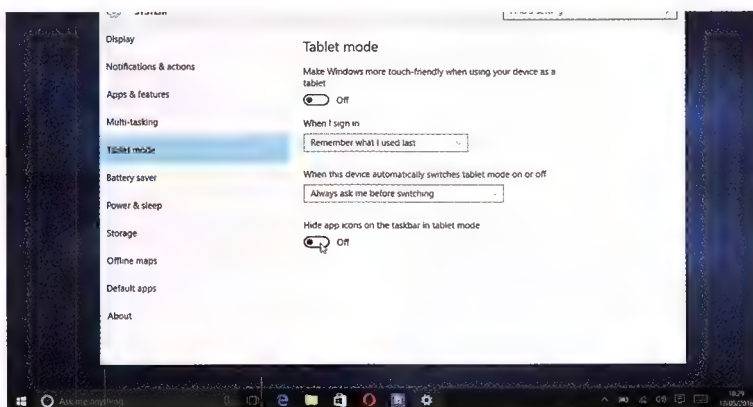
Windows 10 introduces a new Task Switcher — simply press 'Win-Tab' and you'll see all of your open windows shrink to fit on your screen. Either click one to switch to it, or drag it to 'Desktop 2' at the bottom of the screen to transfer it to another (virtual) desktop. You can organise windows over multiple desktops (click '+' to create new ones) by dragging them to the desired desktop. Hold 'Ctrl-Win' and hit the left and right arrow keys to move between desktops.

13 EASY COMPRESSION FOR LARGER FILES

Need to send a number of files to someone, but worried they're too large to attach to an email? Just select all of the files you want to work with, right-click, and then select 'Send To' followed by 'Compressed (zipped) Folder'.

14 PREVIEW PROGRAM WINDOWS

With more than one instance of a program running, you may not be able to tell which one you want to switch to next. To make things a little easier, hover the mouse over a program's Taskbar button to display a preview of any currently running program. Move the mouse over one of the



8 FINE-TUNE YOUR HYBRID TABLET/PC

If you've bought a cheap two-in-one tablet/laptop device, and you're frustrated by Windows switching automatically between tablet and laptop mode when you undock your keyboard, simply open Notification Centre and tap 'Tablet Mode' to switch manually. Click 'Start > Settings' and browse to 'System > Tablet mode' to tweak related settings, such as leaving the Taskbar on-screen at all times, even in Tablet mode.

previews, and you can take a peek at a full-screen preview, then click to switch.

15 LOCK WITH A KEY PRESS

Stepping away from your computer for a couple of minutes? Keep it safe by pressing 'Win-L' to lock it. It's that simple!

16 SCROLL INACTIVE WINDOWS

Windows 10 makes it possible to scroll windows that aren't active – just roll your mouse over the window, then use your wheel to scroll without clicking to select the window. Switch this feature off via 'Settings > Devices > Mouse & touchpad' if it annoys you.

17 COMPATIBILITY MODE

Some older software that you rely on may not work as you expect under Windows 10. Try right-clicking the shortcut of a troublesome program, then select 'Properties > Compatibility tab'. Check the box in the 'Compatibility Mode' section and select the version of Windows it worked with – this setting may get it up and running again.

18 TASKBAR BUTTONS ON YOUR TERMS

Windows saves space by combining windows from the same app into one Taskbar icon. Prefer to see each window individually? Right-click the Taskbar, select 'Properties' and use the 'Taskbar buttons' drop-down menu to choose between the 'Always combine, hide labels' and 'Never combine' options.

19 CALCULATE AND CONVERT

The calculator is capable of much more than simple addition and subtraction – click the menu button and you'll find scientific and programmer options, a date calculator and various unit conversions, too.

20 CHANGE WINDOW SIZES WITH A SHORTCUT

There are lots of ways you can change the size and position of an open window. Hold 'Win' and press the up arrow to maximise a window or the down arrow to minimise it. You can also use 'Win' in conjunction with the left and right arrow keys to snap the currently selected window to the left or right-hand side of the screen. Quickly tidy things up by pressing 'Win-Home' to minimise

everything except the current window, too.

21 CUSTOM WINDOW SIZES

Visit www.brianapps.net and download Sizer 3.4 – this tool enables you to resize windows to custom-set sizes. Due to changes in Windows, make the width 14 pixels longer than you need, and the height seven pixels – for example 1,294 x 807 for 1,280 x 800.

22 REARRANGE THE NOTIFICATION AREA

If you don't like how icons are ordered in the notification area of the Taskbar, they can be simply dragged and dropped into new positions. Perfect for tailoring the Taskbar to suit your needs.

23 FREE UP DISK SPACE

To keep your hard drive running well, it's a good idea to clear out the clutter. Type "cleanmgr" into the Search bar to quickly launch Windows' own Disk Cleanup tool, or download CCleaner from www.piriform.com for a more powerful cleaning application.

24 MINIMISE ALL WINDOWS AT ONCE

To quickly minimise all of your open programs and windows, press the 'Win-M' key combo at the same time. Alternatively, grab a window with your mouse and shake it. This gesture leaves the shaken window alone, but minimises all others.

25 PREVIEW YOUR FONTS

Open the Fonts folder from the Control Panel and you can preview the fonts you have installed without even having to run anything. Any you don't need can be hidden or deleted –

we recommend backing these up first by copying them to another folder.

27 SELECT YOUR FILES MORE EASILY

When you need to select multiple files, it can be quicker and easier if you use check boxes. Open File Explorer and switch to the View tab. Check the 'Item check boxes' box and when you roll your mouse over a folder or file, you'll see a check box appear – check this to select the file, then repeat for all the others you wish to select.

28 USB SPEED-UP

Speed up an older PC with 2GB RAM or less by simply inserting a USB drive! Plug one in, and in the AutoPlay menu that appears, select the 'Speed up my system' option to enable the ReadyBoost feature. You can then choose how much space should be used to help your computer's memory.

29 SHOW ALL YOUR DRIVES

If you would prefer to see all drive letters at all times, click 'Options' under the File Explorer ribbon's View tab. Next, select this dialog's View tab, uncheck the box labeled 'Hide empty drives' and then click OK – now all of your drive letters are visible, even those with no media inserted.

30 AVOID THE REGISTRY

Want to tweak Windows settings without getting your hands dirty? Download and run Ultimate Windows Tweaker 4.0 from bit.ly/uwt-win10, where you'll find loads of handy tweaks and customisation settings that require a single click to apply. Take a Restore Point before you begin using the handy button in the app.

31 GIVE NETWORK LOCATIONS A LETTER

If you have a frequently accessed network folder, speed things up by assigning it a drive letter. Navigate to the network location in Explorer, right-click it and select 'Map network drive', then choose your new drive letter.

32 VIEW CLOCKS FROM OTHER TIME ZONES

The Taskbar shows you the current time and can also be used to check the time in up to two other countries. Click the time in the Notification area and choose 'Date and time settings'. Scroll down and click 'Add clocks for different time zones'. Check 'Show this clock' and use the drop-down menu to configure it.

26 CLEARTYPE LOOKS AMAZING

ClearType ensures text looks great on screen, but it can be fine-tuned. Click Start and type "cttune" to access the ClearType Text Tuner, where you're guided through the process.

← ClearType Text Tuner

Click the text sample that looks the best to you (2 of 5)

The Quick Brown Fox Jumps
Over the Lazy Dog. Lorem
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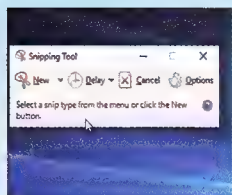
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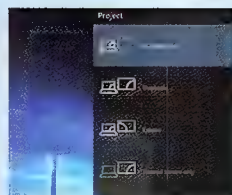
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pellentesque quis, pretium.

Next Cancel



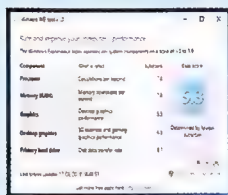
33 TAKE SCREENSHOTS

The Snipping Tool is the perfect way to capture an image of what's happening on your desktop — particularly handy for screenshots and troubleshooting.



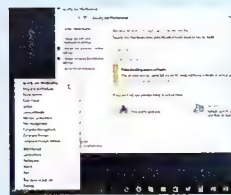
34 PROJECT YOUR DESKTOP

Built-in support for projectors means that connecting your laptop to a projector is incredibly simple. Just hit 'Win-P' to view projector options.



35 CHECK PC PERFORMANCE

You can manually run the Windows Experience Index tests in Win 10 by installing the WEI Tool from: winaero.com/download.php?view.79



36 WHERE'S THE ACTION CENTER?

Wondering where it's gone? Type "action" into the Search box, and click 'Security and Maintenance' to find notifications of problems and fix-it tools.



37 CHECK YOUR MEMORY USAGE

To see which running apps use up memory, right-click Taskbar, select 'Task Manager', then 'More Details'.

38 RESTORE LIBRARIES

Libraries are hidden by default in Windows 10 — bring them back by switching to the View tab of File Explorer, then click the 'Navigation pane' button and pick 'Show libraries'.

39 PERSONALISED DISPLAY CALIBRATION

If you like to be in complete control over how your display is calibrated, type "dccw" into the Search bar to access the Display Colour Calibration Wizard. To proceed, click 'Next' and the wizard then helps you to choose the best display settings.

40 RESTORE CLASSIC LOOKS

If you don't like the way the way certain items are now displayed in the Notification area of the Taskbar (we're looking at you, battery, time and date display, and volume control), you can restore the old look. Ordinarily, you'd need to tweak the Registry, but simply fire up Ultimate Windows Tweaker (see Tip 35), then go to 'Customisation > Windows 10 tab', where you'll find the options you need.

41 CYCLING BACKWARD

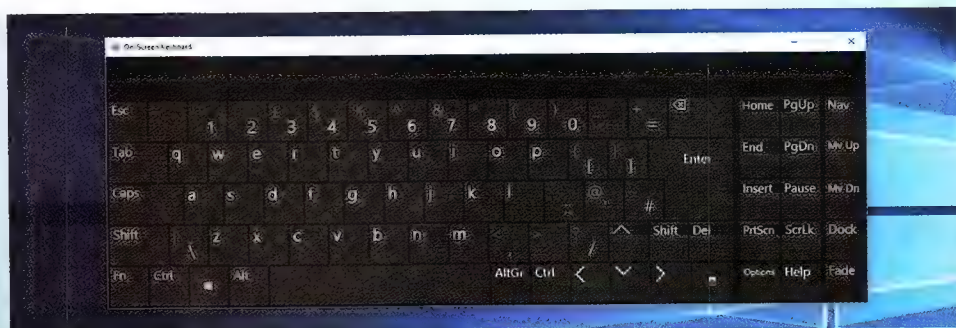
The Classic task switcher ('Alt-Tab') still remains — tap it to cycle forward through the list of windows. Hold Shift as well as Alt and Tab, and you can cycle backward, too.

42 DISABLE HIBERNATION AND FREE UP SPACE

Windows' hibernation file takes up a lot of space, particularly on machines with lots of RAM. Disable it to recover the space by right-clicking the Start button, and choosing 'Command Prompt (Admin)'. Type "powercfg -h off" and hit Enter.

43 ON-SCREEN KEYBOARD

If you're having trouble with your keyboard and need to buy a new one, there's an on-screen one you can use in the meantime. Type the command "osk" into the Cortana Search bar and press Enter to bring it up.



44 ACTIVATE WINDOWS WITHOUT CLICKING

Want to bring windows into focus simply by rolling the mouse over them? Type "ease of access" into the Search bar, then choose 'Ease of Access Centre'. Click the link labeled 'Make the mouse easier to use' and then select the option labeled 'Activate a window by hovering over it with the mouse' in the 'Make it easier to manage windows' section.

45 QUICK AND EASY COMMAND PROMPT

Hold Shift while right-clicking a folder, and you'll reveal the previously hidden 'Open command window here' option. This option takes you to that location in the command prompt window.

46 RUN AS ADMINISTRATOR

You can run any program in the Taskbar in the role of an administrator by simply holding down 'Ctrl-Shift'.

47 TAKE CONTROL OF UAC

User Account Control is a great security feature, and you can adjust just how sensitive it is to suit your preferences. Click the Start button, type "uac" and

press Enter. You can then use the slider to choose when warnings should appear.

48 CYCLE THROUGH A SINGLE APP

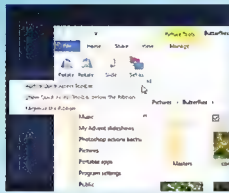
We all know that 'Alt-Tab' is a handy shortcut for cycling through programs. If you want to cycle through just one program's open documents or windows, hold down the Ctrl button and click its Taskbar icon until you access the window you're looking for.

49 OPEN FILE EXPLORER AT THIS PC

Open File Explorer and it defaults to the Quick Access folder. If you'd rather it went to your drives instead, select 'Options' under the View tab and choose 'This PC' from the drop-down menu.

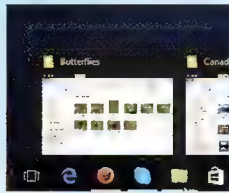
50 CREATE YOUR OWN SHORTCUTS

Create custom keyboard shortcuts to launch your favourite programs. Right-click a program shortcut, pick 'Properties > Shortcut tab', select the 'Shortcut key' field, press the keyboard combo you'd like to use, then click OK.



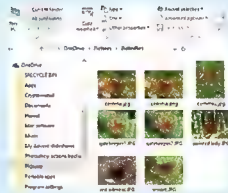
51 FAVOURITE COMMANDS

Make favourite ribbon commands more accessible in any supported app: right-click the option and choose 'Add to Quick Access Toolbar'.



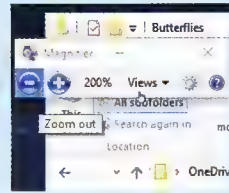
52 QUICKLY CLOSE WINDOWS

When looking at a Taskbar preview of a program or window, just click the middle mouse button to close the window without having to switch to it.



53 JUMP TO SEARCH

When you want to search for a file within a particular folder, simply press F3 to jump to the search box, enter your chosen search term, then hit Enter.



54 ZOOM IN AND OUT

To get a better view of what's happening on your desktop or in a program, press 'Win' and '+' to zoom in. Use 'Win' and '-' to zoom out again.



55 ARRANGE YOUR WINDOW

Right-click the Taskbar and click either 'Show windows stacked' or 'Show windows side by side'. You can right-click again to access the undo option, too.

56 GET MORE FROM YOUR LARGE MONITOR

Massive monitors with super-high resolutions can make on-screen text too small to read easily. Adjust this via 'Start > Settings > System > Display' — use the 'Change the size of text, apps, and other items' slider to push things up. Type "DPIScaling" into the Search bar to access another dialog box, where you can control specific items.

57 SIDE-SCREEN TASKBAR

If you'd prefer to make better use of the width of your widescreen monitor, move the Taskbar to the left or right, rather than the bottom of the screen. Right-click an empty section of the Taskbar, and make sure that the 'Lock the Taskbar' option does not have a check next to it (if it does, just click it to remove it). You can then drag and drop the Taskbar to your preferred position, before locking it in place again. Give it a go!

58 RECORD ANY PROBLEMS YOU EXPERIENCE

There may be times when you

run into a problem with your computer, and don't know how to remedy it. It can be difficult to explain what's going wrong to someone else, which is where Problem Steps Recorder can help — it makes it possible to record what happens on screen and send it to someone who might be able to help. Type "psr" into the Search bar, and choose 'Steps Recorder'. Click 'Start Record', and use your computer until the problem occurs again. Click 'Stop Record' before saving and emailing the file.

59 SEND TO MORE PLACES

The 'Send To' section of the context menu is very useful. If you hold down Shift while right-clicking a file or folder, you'll see an expanded list of options in the submenu that appears.

60 SEE HOW YOUR PC IS BEING USED

Windows' Resource Monitor enables you to see how your processor, memory and hard drive are being used. Press 'Win-R', type "resmon" and press Enter. The graphs reveal how

individual programs and processes are making use of your hardware.

62 REPAIR A PROBLEMATIC PC

Problems can arise and you may wish to reboot into a Windows troubleshooting mode. To do this manually, hold Shift as you click 'Start > Power > Restart' to boot into the Advanced Start-up screen. You'll find a number of options here — to get into Safe mode, for example, select 'Troubleshoot > Advanced Options > Start-up Settings > Restart', then select your chosen mode — '4' for Safe mode on its own or '5' for Safe mode with Internet access — to boot into it.

63 SWITCH KEY WINDOWS TO A DARKER THEME

Windows 10 offers a hidden dark theme for system settings and built-in apps. Open Ultimate Windows Tweaker, and select 'Customisation > Windows 10'. Uncheck both 'Apps Use Light Theme' and 'System Uses Light Theme' and click Apply. The change is immediate and you can easily reverse it by simply checking both boxes again.

64 CONTROL AUTOPLAY

Click 'Start > Settings > Devices > AutoPlay', and you can take control of what happens when you insert a disc or plug in an external drive. You can opt to disable AutoPlay completely as well.

65 SAVE OFFICE FILES IN WORDPAD

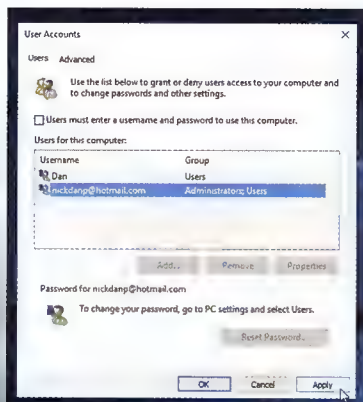
It might seem like a simple tool, but the WordPad program has more capabilities than you might think. If you click the 'File' option, followed by 'Save As', you can save in the Office DOCX format without the need for additional software or applications.

66 LEAVE YOURSELF A HELPFUL NOTE

There's no need to clutter your desk with a hundred different paper notes and reminders — you can leave electronic reminders on your desktop instead. To do this, launch the Sticky Note tool from the Start menu, and create notes as and when you might need them. You can even right-click notes to customise their colour. This simple feature is a great way to help them to stand out.

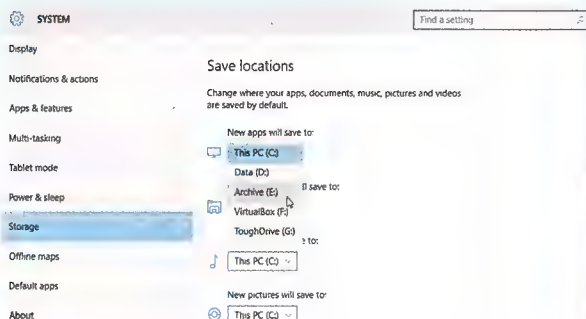
67 PLAY MUSIC ON ANOTHER COMPUTER

Windows Media Player can be used to play



61 LOG ON AUTOMATICALLY

Get to work faster. Press 'Win-R', type "netplwiz" and press Enter. Uncheck the box labeled 'Users must enter a user name and password to use this computer', then select your account before clicking Apply, and entering your password when prompted. Click OK and you're done!



74 MOVE APPS TO NEW DRIVE

If you're running out of space on your hard drive — or have a tablet with limited onboard storage — navigate to 'Settings > System > Storage' and scroll down to the 'Save locations' section. Click the drop-down menu under 'New apps will save to' and select another drive with more space. You can move some (but not all) existing Windows Store apps, too, if space is really tight — switch to 'Apps & features', then click the app you'd like to transfer. If 'Move' isn't grayed out, click it, select your destination and click 'Move' again to transfer the app.

local or network music files, but you can also push music to play on another computer as well. You need to set this up in advance, so launch Windows Media Player, click the 'Stream' button, and then select 'Turn on media streaming'. In the window that appears, click the 'Turn on media streaming' button. Back in Windows Media Player, click the Stream button again, and then select 'Allow remote control of my player > Allow remote control on this network'. Next, select 'Stream', followed by 'Automatically allow devices to play my media' — repeat on other computers on your network. Then right-click a music file and select 'Cast to Device', before selecting a PC or other device for playback.

68 RESTORE WINDOWS PHOTO VIEWER

You'll either love or hate Windows 10's new Photos app. If you hate it, this following tweak enables you to restore the classic Windows Photo Viewer as the default: open Ultimate Windows Tweaker again, switch to the 'Additional' section and click 'Enable Windows Photo Viewer'. Once done, make it the default for viewing photos once more under 'Settings > System > Default apps'.

69 VIEW A SLIDESHOW ON YOUR DESKTOP

Can't decide which picture to use as your background? Use a rotating slideshow instead. Right-click the desktop, then select the 'Personalise' option. Click the Background drop-down menu and choose 'Slideshow'. You're prompted to select a folder containing the images you wish to include — do so, and decide how frequently the image will change. This is great for keeping the boring old desktop fresh and interesting.

70 OLD-STYLE TASKBAR CONTEXT MENUS

When you right-click a button in the Taskbar, you gain access to jump lists. If you'd prefer to see options to maximise, minimise and close windows instead, hold down Shift while you right-click the Taskbar button.

71 DESKTOP TIDYING

If you have icons everywhere, right-click the desktop and choose 'View > Auto arrange icons'.

72 CUSTOMISE SEND TO

Many programs add entries to the 'Send to' menu, but you can also add your own. The simplest way is with the help of Send To Toys (gabrieleponti.com/software).

73 GET MORE SCREEN SPACE

You can see more of the desktop and your running programs by shrinking your Taskbar buttons. Right-click the Taskbar, and select

'Properties' — on the Taskbar tab, check the box labeled 'Use small Taskbar buttons' to shrink them.

75 GET MORE TASKBAR

Conversely, you might want a larger Taskbar, so you can see more buttons or extra running programs. Right-click the Taskbar and ensure the 'Lock the Taskbar' option is not checked. You can drag the top of the Taskbar upward to make it even taller.

76 TWEAK YOUR QUICK ACCESS SETTINGS

The Quick Access area in File Explorer juggles frequently and recently accessed folders with pinned folders of your choosing. Switch to the View tab and click 'Options' to choose whether or not to display recent files and frequent folders here.

77 KEEP BROWSING IN PRIVATE

You can keep your browsing history private in the new Edge browser by switching to InPrivate mode. You can do this by pressing the combo Ctrl-Shift-P.

78 REDUCE SYSTEM SOUNDS FOR CALLS

To prevent the music you're listening to interfering with computer-based phone calls, you can opt to automatically have the volume level of system sounds reduced when a call is underway. Right-click the speaker icon in the notification area, and select the 'Sounds' option. Move to the Communications tab and select one of the three options to reduce volume or completely mute sounds.

79 VIEW ALL NOTIFICATION ICONS

Windows saves space by hiding some icons from the notification area. To see them at all times, click 'Start > Settings > System > Notifications & actions' and click 'Select which icons appear on the Taskbar'. Make sure you flick the

switch labeled 'Always show all icons and notifications on the Taskbar' to 'On'.

80 UNDO THAT UNINTENTIONAL MOVE!

If you accidentally move, copy or send a file to the Recycle Bin, you can press 'Ctrl-Z' to reverse the mistake. Phew!

81 CHECK YOUR ENERGY EFFICIENCY

Right-click the Start button and choose 'Command Prompt (Admin)'. Type "powercfg -energy" and press Enter. After a minute or so of loading, navigate to the folder you're told about (typically C:\Windows\System32), and open up the file energy-report.html. This shows you what to do to improve energy efficiency.

82 MAKE INDIVIDUAL SETTINGS ACCESSIBLE

Got a favourite tweak you frequently find yourself burrowing into Settings to find? You can create one-click shortcuts to them a number of different ways. The simplest thing to do is pin it as a tile to the Start menu, simply by locating it in 'Settings', then right-clicking its entry in the left-hand pane, and choosing 'Pin to Start'.

83 CHOOSE YOUR SHUTDOWN OPTIONS

The power button can be used to do many things — restart, shut down, sleep and so on — and you can choose what should happen by default. Right-click the Start button, select 'Power options', then click 'Choose what the power buttons do' to access the relevant options.

84 ADD TABS TO FILE EXPLORER

File Explorer in Windows 10 is an improvement on Windows 7, but it's still lacking in one key area: no tabbed support to prevent you cluttering up the desktop with multiple windows. Clover 3 is a

free extension that adds Chrome-like tabs to File Explorer – go to: www.ejje.me to get it.

85 UNDELETE YOUR FILES

It's easy to forget how handy the Recycle Bin folder is. If you've deleted a file, document or folder that you need back, open up the Recycle Bin from the desktop, and you'll find your files are there ready to be restored.

86 SEARCH WITH CORTANA

Type the name of a file or folder into the Cortana search box and you'll get a load of irrelevant results – click 'My stuff' to search your hard drive and other storage, including your OneDrive folder, for your missing files. Use the 'Show' drop-down menu to filter the results.

87 TALK TO YOUR PC

If you can't type very quickly or just fancy trying out something a little nifty, type "speech" into the Search box and select 'Windows Speech Recognition'. Here you'll find everything you need to configure your PC for voice-activated control – it's great for dictation, too, actually.

88 MONITOR THE CHILDREN

While parents want to let their child use a computer, they also want to ensure their kids are kept safe. Go to 'Start > Settings > Accounts > Family & other users' to set up user accounts for your children that you can configure to protect them while online, plus manage their computer usage and monitor what they do.

89 ACCOUNT SHORTCUTS

Click Start followed by your user picture and you'll see some handy options: lock, sign out and switch user, plus access the 'Change account settings' screen.

90 PIN SAVED SEARCHES TO THE START MENU

File Explorer's search tool is powerful – for example, you can set up a search to reveal all recently modified Word documents in a folder from that location: just type "type:word datemodified:this week" into Search. Click 'Save search' to add it to your Searches folder, then go there, right-click the search and choose 'Pin to Start'.

91 RESTRICT CORTANA

By default, Cortana favours web results over locally stored

content. You have to click 'My Stuff' to search locally. If you have no use for Cortana as a web search tool, open it, click the notebook icon on the left, then select 'Settings' from the menu. Flick the top switch to 'Off', which reveals a new switch: 'Search online and include web results'. Flick it to 'Off' and you'll see the search box now only says 'Search Windows'.

92 ALL SETTINGS IN ONE PLACE

It's been dubbed God Mode, but it is just a handy way to access a massive range of options in one place. Create a new folder, and type the name "xxx.{ED7BA470-8E54-465E-825C-997120 43E01C}". You can change the "xxx" to anything you like, and when you open up the folder, you're presented with a list of Control Panel options to work with, including tweaks not found in the newer Settings app.

93 LAUNCH A WEBSITE FROM THE TASKBAR

Sometimes, it can be too much trouble to switch from the program you are working in, move to a browser and place the cursor in the address bar, before typing a URL. Instead, type the web address you want to visit into the Cortana search bar and it goes straight there in your default web browser.

94 CREATE A BOOT DISC

It's good to be prepared and this is where a recovery drive comes into play. Type "recovery" into the Search bar and choose 'Create a recovery drive'. If you have a Windows installation disc, uncheck 'Back up system files to the recovery drive' to save space, before clicking 'Next'. You should then select a USB flash drive to create the drive on. If necessary, boot from this drive to access repair options when Windows itself refuses to boot.

95 USE ENCRYPTION WITH YOUR DRIVES

If you're running Windows 10 Pro, type "bitlocker" into the Search bar to switch on Bitlocker drive encryption. If you're not running Pro, download the free VeraCrypt app from veracrypt.codeplex.com.

96 GIVE YOUR STARTUP A GOOD SPEED-UP

Right-click any shortcuts to programs you don't need in the 'Start-up' group of the Start menu

and delete them. This helps to significantly reduce your computer's boot times.

97 CREATE NEW FOLDERS QUICKLY

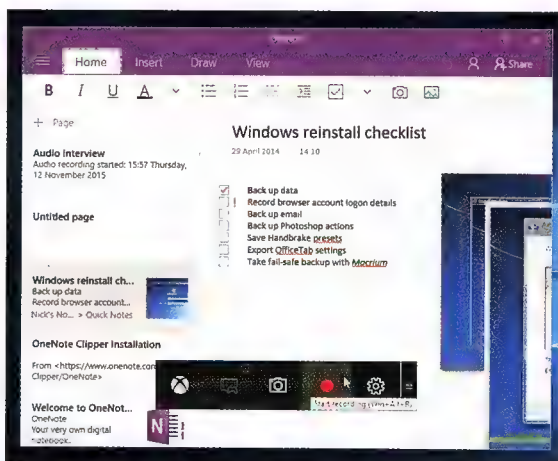
There's no need to lift your hands from the keyboard when you need to create a new folder in Explorer. To carry out this handy trick, use the special keyboard shortcut 'Ctrl-Shift-N', type a name for the folder and press Enter.

98 PERSONALISE YOUR PC'S INFORMATION

You can change what's displayed in the System Properties screen to just about anything you like (within reason). The information is held in the Registry, but why fiddle about there? Instead, fire up Ultimate Windows Tweaker and navigate to the 'Additional' section. Click the 'Edit OEM Information' button and enter your details – you can even include a logo, too. You'll need to prepare a 120 x 120-pixel image in your image editor and save it with the .BMP extension, otherwise it won't appear.

99 MAKE GOOD USE OF THE QUICK ACCESS MENU

Right-click the Start button or press 'Win-X' and you open up a hidden Start menu. It provides a number of convenient shortcuts to powerful tools, including various Control Panel applets, Device Manager and the Command Prompt. Add your own or rearrange and delete existing shortcuts, courtesy of the Win+X Menu Editor. Download the app from winaero.com/download.php?view.21 and you'll find it's easy to add handy presets, such as Control Panel applets and administrative tools, as well as custom shortcuts.



100 RECORD APP ACTIONS IN WINDOWS 10

Windows 10 features a Game DVR function, which enables you to record your progress in a game as a movie, if your hardware supports it. What's less well known is that this DVR function works with any app you install from the Windows Store. Simply press 'Win-G' when inside your target app, and check 'Yes, this is a game' when prompted. If you plan to share your video with others, it makes sense to set it to the correct aspect ratio: 16:9 or 16:10 is usually best. Use Sizer (see Tip 21) if you're struggling to get the window size perfect for your intended audience. ■



RECOVER YOUR DATA

Nothing is lost until you've looked for it, says Alex Cox.

Imagine with us: The worst has happened. Everything you held dear is gone. You ignored the clicking of the hard drive, those error messages, that suspicious-looking file for too long. You clicked the thing you shouldn't have clicked. You emptied the Recycle Bin out of habit after letting your kids near your PC. And now? Now your photos are gone, your documents are dust, those precious family videos cast to the wind. Windows has gasped its last breath. All is lost.

Except that isn't necessarily the case. Data has a habit of hanging around. And if you're very lucky, and very careful, you could – in this

hypothetical scenario – get all, or the vast majority, of your data back. Note that we're not going to be able to help you a huge amount in the case of massive hardware failure or physical damage, so if you've inadvertently sent 120V to that SSD, or unwisely dunked your laptop in the bath, you're either going to be on the hook for specialist clean room data recovery, which could set you back thousands of dollars, if it works, or completely out of luck.

If you're not just imagining things, and everything does appear to have gone, stop using your PC immediately and read on. And if everything seems fine, read on anyway. You might learn a few things that'll save your bacon one

day, and we'll help you get your hands on some tools that every home computer pro should have waiting in their back pocket for the worst of times.

And don't worry – we've not discounted the possibility that Windows has simply collapsed under its own weight, rendering your precious data comfortably stored, but otherwise inaccessible. By accessing your drive from another operating system entirely, you'll be able to get all that stuff back, too. And hey, if you fancy doing a bit of digital forensics, but your drives are currently in a good state, why not delete a few old files from a USB stick and follow along?

feature » recover your data

Before we can even think about doing any kind of data recovery, it's worth knowing how data is stored on the typical drive. Every situation is slightly different, of course, and we're taking an incredibly basic look at NTFS formatting here; other filesystems work in different ways, although, with the right software, you should be able to affect a recovery from just about anything.

The typical drive is broken into partitions. These aren't physical breaks, they're logical — a certain portion of the drive's bits are allocated, in a contiguous manner, to split the drive apart into individually managed sections, known as 'volumes'. Information about these volumes — their size, location on the drive and the like — is stored in the drive's Partition Table, which sits alongside the Master Boot Record (MBR) in the first sectors of the drive. The MBR is accessed when you boot your PC, so the BIOS knows where it's heading.

Each volume is invisibly broken into more sections. The Master File Table (MFT) is the most important of these. It's a database that contains information about every file and folder on your drive, pointers to them and, in some cases, even entire files, if they're smaller than about 512 bytes. Before the MFT is a boot sector, which holds a bit more specific information about the volume — most importantly, it points to where the MFT is located — and, if the partition is both active and designated as a primary partition, loads NTldr to kick off the boot process. The same sector is also duplicated at the very end of the volume, in case the first one goes bad, as is the MFT itself.

Don't let Windows update if you're missing crucial files.

Restart required
We'll restart your device outside of active hours. Select this message to change active hours or restart now.

Restart now

Sandwiched between these tiny sections is the filesystem data itself — the stuff the MFT points to. These are your files. When you start a fresh NTFS drive, they're stored quite neatly; a few months or years into the drive's life, they really are not. Files are placed into whatever space the MFT designates as free, and while the system makes a good stab at doing this sensibly, it often needs to break your files apart, and spread them over several areas of free space, with the references to each of the parts stored in the MFT. This is why mechanical drives tend to slow down; the read head needs to jump around the drive to hit each bit of the thing you're trying to load. SSDs don't have this problem, since they can jump between sectors almost instantaneously (relatively speaking, at least).

STAYING SAFE

So what does this all mean for you? Well, consider this: When Windows deletes a file, it doesn't do anything to the filesystem data. It merely scrubs the reference from the MFT, and allocates the file's space as "empty". The data itself is still there, almost in

its entirety. For now. If the MFT later chooses to store a new file in the same space? Some or all of that deleted file's data will be gone.

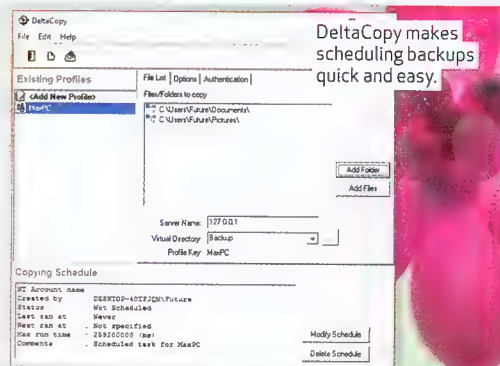
This means the first critical step of any data recovery effort (and a point we're going to keep making) is to stop what you're doing immediately, and power down the drive. Don't risk any of your data being inadvertently overwritten, because if you want it back, you want it intact. Usually, you'd shut down your machine using the regular Windows shutdown procedure, which is certainly the optimal choice if your problem is hardware failure, rather than a filesystem glitch. It means your drive's heads (if it has them) are properly and safely disengaged, and any write operations completed properly, thus avoiding potentially corrupted files.

But there's an issue with this: If you have Windows updates waiting, shutting down in the regular way is essentially giving Microsoft license to begin overwriting swathes of your drive's precious bytes with patches that are, at least in the current circumstances, less than helpful.

Proactively preventing data loss

Recovering files is our aim here, but all of this can be avoided with a sensible computing regime. If you care about your data, build in a backup routine. The prevailing wisdom states that you should follow the rule of three (three copies of your data, stored on at least two kinds of media, at least one of which is kept off-site), and it makes sense to get as close to this as you can. Start duplicating your critical files to a cloud backup service such as CrashPlan, and using external media to keep secondary copies of the most important items. Copying them to another partition on the same drive — or another physical drive in the same machine — is not adequate. Move your backup away from your main machine — to a different floor of your house, perhaps, or even off-site. If you're hit by a flood or a fire, your insurance might buy you a new PC, but it won't cover your files.

An automated process is best — again, something that CrashPlan and its ilk offer — because it pulls vital files when you're not using your machine, ensuring they're duplicated when disaster strikes. If you don't want to pay for a subscription, it's plausible to back up small pockets of files on free services such as Google Drive or Microsoft's OneDrive, but unless you're organised with your local and mirrored folders, you're one step



away from a forgetful accident. If you want to take it further and customise your own backup solution, check out Linux app `rsync` (linux.die.net/man/1/rsync), which has a Windows wrapper in the form of DeltaCopy (www.aboutmyip.com/AboutMyXApp/DeltaCopy.jsp) — you won't find a more versatile app when it comes to cloning data.

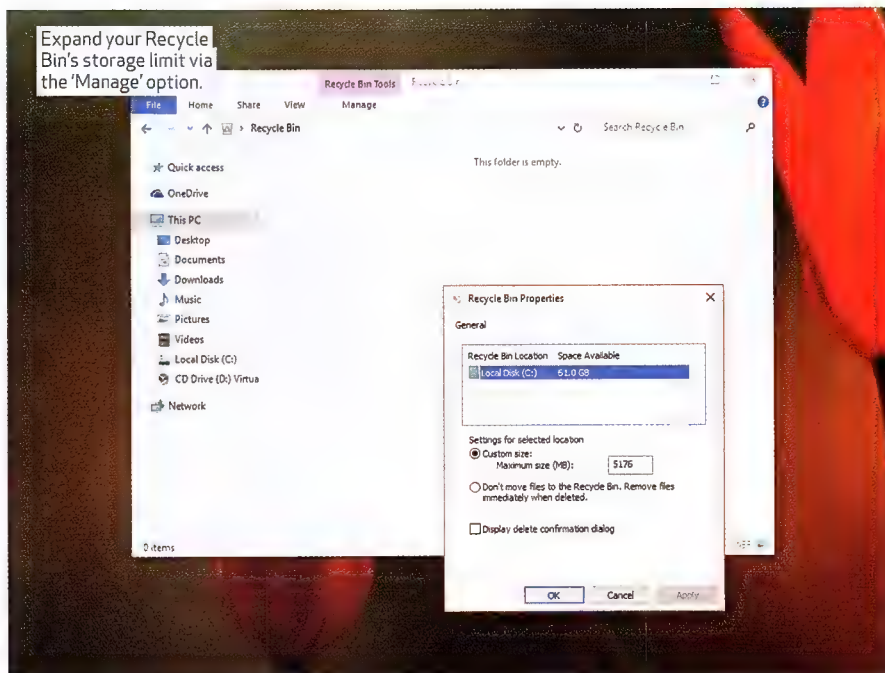
So if you've headed for the Start menu to shut down, and you're getting the dreaded 'and update' suffix, it's time to do something we'd ordinarily never recommend: cut the juice. Don't even hold down your power button for 10 seconds — cut the power at the wall, flick the switch on your PSU, or pull the battery if you can. The next time we use this drive, it'll ideally be in read-only mode, which mitigates most of the risk to your data.

VITAL PREPARATION

What's gone wrong? We don't know for sure. You might, though. The structure of your drive means there are a few potential points of failure – the MBR, the partition table, the MFT, a problem with bad sectors in the file storage area – and that's not to mention mechanical issues, a problem with your motherboard's drive controllers, a malicious attack or the ultimate destroyer of files: you. We'll come to human error later on. For now, we need to help the people who haven't done something silly.

If you have a donor machine you can hook the drive up to (as a secondary drive), that's ideal. If you don't have that luxury, you need to cross your fingers that your file loss isn't being caused by a malfunction on your current machine. Keep it powered down for now. Whatever the situation, have a fresh external drive ready to transfer any recovered files to, and be aware that you may need to do a little manual cleaning up after.

Now, head to a second machine. If you're reading this and you haven't actually suffered any data loss as yet,



follow this advice anyway: As any good Boy Scout knows, one must always be prepared. On your second machine, download the x86 version of System Rescue CD from www.system-rescue-cd.org, and write it to a CD or USB stick. There are many rescue-focused distros of Linux, but this one – ugly text-based interface and all – is ours.

PARTITION RECOVERY

Time to get some stuff back. Plug in your large external drive, and boot your affected machine from your System Rescue CD media. You may have to head into your UEFI menu and

disable Secure Boot before it works. Hit Return to boot with the default options, and you're thrown straight to a command prompt. OK, not the most welcoming introduction, but we don't need graphical finery for these tasks.

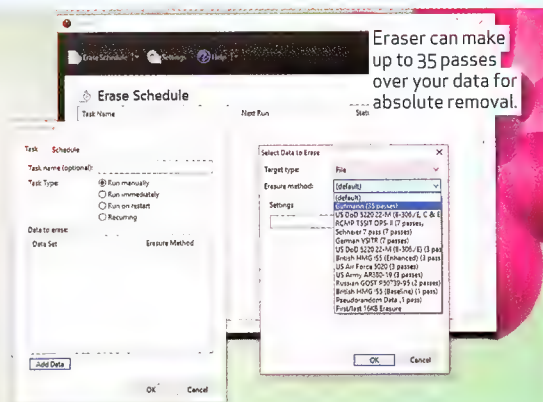
You may see a suggestion to mount your drive at this point – don't do it. This is a trap for young players; if your partition table is hosed, you're going to want to work on the raw disk first of all. So type `testdisk` and you can begin taking a look at your connected hardware. Don't worry about creating a log file at this point.

How to erase data completely

We've discussed the ways in which your drive stores files and how they don't really get removed when you delete them or format your drive. What if there are files on there that you really want to stay deleted, and be excluded from any recovery efforts? We can use a little of our knowledge of file storage to work out how to obliterate old data — the best way to make sure files don't rise from the dead is to ensure that 'free' space on your drive is completely overwritten. You could painstakingly write files to your drive until it's full, but that's madness. Better to use a secure deletion tool.

You have a few choices here, but we tend to favor Eraser (eraser.heidi.ie), which goes overboard in its efforts, overwriting your files several times with specific random data patterns in order to remove them — and on magnetic drives, the microscopic traces they leave behind — completely. We recommend you keep it hanging around: you can securely delete files just by dropping them on the app, or even have it grind through any unused space on your partitions, applying its algorithms to that space to scrub it clean of any ghostly data.

If you really want to get rid of all the data on a drive — if you're passing your hardware on or recycling it, say — System Rescue CD includes the tool Wipe (wipe.sourceforge.net), which does



an intense, thorough, repeated overwriting of every byte of data on a drive. Or if the hardware doesn't matter, and you're absolutely desperate to get rid of it, do as one of APC's alumni once did: Take a hammer to your drive and throw it in a lake. But think of the fish before you do it.

TestDisk 7.0, Data Recovery Utility, April 2015
 Christophe GRENIER <grenier@cgsecurity.org>
<http://www.cgsecurity.org>

Expand your Recycle B If you see this ominous message in TestDisk, your partition table is hosed. In's storage limit via the 'Manage' option.

Disk /dev/sda - 8589 MB / 8192 MiB - CHS 1044 255 63

Current partition structure:

Partition	Start	End	Size in sectors
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Partition sector doesn't have the endmark 0xAA55

You're first given a list of all the connected storage devices – with luck, you'll see the affected drive. If you don't, you can safely diagnose your problem as physical: Meaning there's a cable loose, a power failure or your drive controller has gone up in smoke. Presuming you do see the drive, take a note of its designation (sda, sdb and so on) as we'll need this a little later. Ensure it's selected, and hit Return, selecting the 'Intel' partition type unless you're working on a particularly odd drive.

Now choose Analyze. One of two things is going to happen now: If your drive is properly structured, it finds the partition table, and lists the partitions – again, take note of these, and those of the external drive you've plugged in for your recovered files. If the partition table of the rogue drive is missing or damaged (TestDisk looks for a particular byte at a particular point on the drive to discover this), you can select Quick Search to have it scan your drive, cylinder by cylinder, for the telltale signs of partition

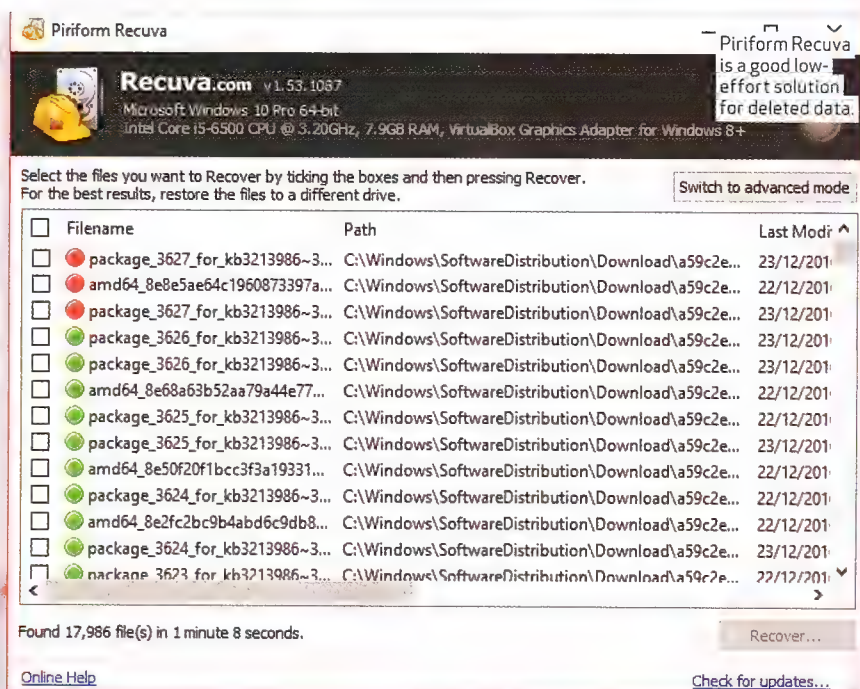
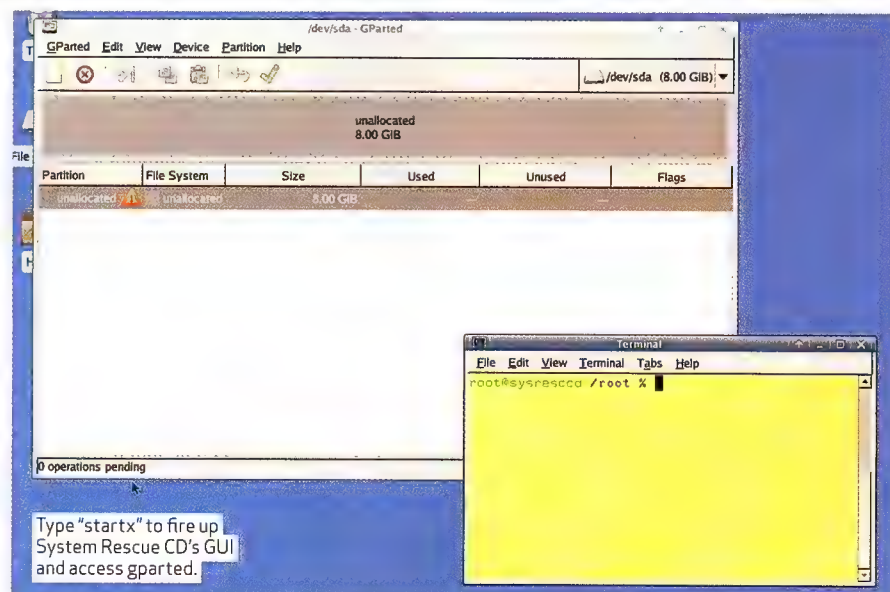
divisions. With any luck, it'll find something and you'll be given the option to restore the partition table. If not, you can choose to do a deeper scan, which is a last-ditch effort;

it takes a long time, and stresses a failing drive, but if you have no other option, it's worth a try.

CONNECTING DRIVES

With a healthy partition table, your drive should be in good enough shape to work with – you can now start hunting for your files. TestDisk usefully comes with a companion program, Photorec, the name of which is somewhat out of date – it doesn't just recover photos, but a host of known file types from a selection of over 480. But before we can use it, we need to mount your secondary drive to give it a location to send the files to. Mounting, essentially, is the process of linking a partition of your drive to a Linux file – absolutely everything in Linux is a file – and telling Linux exactly how it should be accessing that drive.

Presuming your backup drive is NTFS formatted, we can use a program called ntfs-3g to do the mounting. First, create a mount point – the folder location that'll represent your drive – by typing `mkdir /mnt/ntfs` at the prompt. Then (replacing 'sdb' with the partition designation that you made a note of earlier) type `ntfs-3g /dev/sdb1 /mnt/ntfs` to solidify the link between the two locations, and bear in



mind that you will need the backup drive to be in good working order, too — if ntfs-3g detects bad sectors or NTFS errors, it forces it into read-only mode. Now fire up Photorec by typing `photorec` at the prompt.

FILE RECOVERY

This is the real meat of file recovery. Photorec uses technical knowledge of partition anatomy and the exact bytes that make up certain file types to skim through your drives and automatically pull off corrupted or lost files. And while its interface is incredibly ugly, it's the most effective tool going. Once you've started it up, pick your affected drive (Photorec only works in read-only mode, so it's safe), choose the partition that you noted earlier, and select Search.

Photorec asks for a location to save its restored files to — navigate through the Linux file tree to find the mount point we made earlier, and pick a folder on your drive if you have one prepared. Hit 'C' when you're done. Photorec now sifts through your drive looking for broken, deleted or incomplete files, and does its best to recover them fully — grab a cold one, because this is going to take a while. All being well, you should have the majority, if not all, of your stuff back at this point.

There are simpler ways to get the job done. You're welcome to stick within Windows and try running the portable version of Piriform's Recuva from a USB stick (www.piriform.com/recuva/builds), which offers a pretty interface and the option to select precisely what you've lost, rather than just batch-copying everything, but it's more limited to inadvertently deleted files, and isn't particularly helpful if you have an ongoing malware issue. There are also overkill methods — for instance, you could, at the other end of the spectrum, use partimage (included with System Rescue CD) to pull off a full bit-for-bit copy of your affected drive, preserving it for later forensic analysis. Check the guide at www.partimage.org/Main_Page to see how it's done — you can compress the image as it goes, fitting it on to a smaller drive than the source and later restore it if you suspect hardware failure.

System Rescue CD has one more niche use, too. If Windows itself has given up the ghost and is blocking your access to your otherwise perfectly stored files, you can mount both your original and backup drives and copy them off directly. Alternatively, and this may be a slightly more comfortable option, you could boot up another Linux live distro — the likes of Ubuntu — and manually back up using a graphical interface.

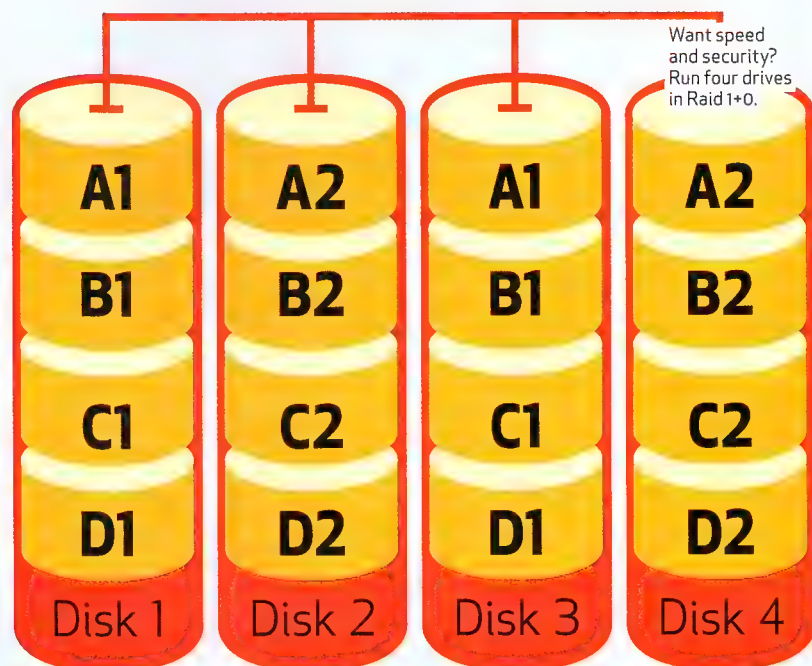


What about RAID?

RAID drives, as you might imagine, can be tricky beasts to recover data from, and certain configurations introduce issues of their own. Run a striped set in RAID 0 formation, for example, and you're asking for trouble — yes, you'll have some of the fastest storage going, but if one of your drives goes down, you're stuck. There are various options that claim to be able to recover files from RAID 0, 5 and 10 — ReclaiMe (www.freeraidrecovery.com) is the most prominent — but don't hold your breath for any decent results. On the flipside of the coin, RAID 1 and similar mirrored configurations positively aid in data recovery; if one of your drives goes down, you may need to invest a little time and money in remirroring with a new drive, but catastrophic failure is only going to come from your own hand or a malware attack. If this is the case, you have the same chance to recover files as you would with a single drive.

The other issue RAID introduces is the controller itself. If whatever's managing your RAID configuration — your NAS, your main computer or specialist RAID hardware — goes bad, it could throw your drives into a position where recovering data is entirely impossible. It's not unknown for specialists to be able to engineer specific tools for specific instances of RAID failure, but this is a highly costly procedure, with no guarantee of success.

We don't have an answer for the irony of RAID being both safer and more dangerous than storing on a single drive, other than to suggest, again, that you always keep stringent backups away from your regular hardware. ■



Qualcomm's in-floor car charging system works by connecting the source and the battery wirelessly via two coils.

SUP



POWER



It's a century-old idea, but wireless electricity is finally coming into its own. Drew Turney learns about the horizons, limits and products you'll use wire-free in the near future.

We've all seen the horror movie with the heroine locked in a cupboard with a killer in the house, desperately trying to call the police while her phone runs out of charge.

Imagine how different the world would be with electrical power delivered not through wall sockets or limited batteries but through the very air, keeping our devices, appliances and machinery charged as we use them? As any science geek will tell you, it's not a new idea. During the early days of electrical power in the 1900s, several names were experimenting with it.

The most famous was Nikola Tesla, who built inductive and capacitive coupling using spark-excited radio frequency resonant transformers — that's the Tesla coil to the rest of us. His successful public demonstrations lighting Geissler tubes (the precursor to neon lighting) and incandescent bulbs using wireless power inspired greater ambitions.

One of his ambitions was a network of balloons, nine kilometres up, transmitting electricity over vast distances wirelessly from suspended electrodes. But Tesla's best-known effort is Wardencllyffe Tower, a 187-foot-tall wireless transmission station on Long Island, New York, intended to transmit information — 80 years before the internet — as well as power.

While Edison supposedly destroyed Tesla's advances with litigation and industrial espionage, funding for Wardencllyffe Tower ran out and it was demolished in 1917.

But Tesla and his peers were still onto something — he might simply have been thinking on too grand a scale. If you've ever seen

a Tesla coil on YouTube, you'll wonder how a machine throwing electrical arcs in all directions can possibly be safe (it's not — see sidebar 'Is wireless power safe?')

THE NEW WIRELESS

But thanks to the work done all those years ago, wireless power transfer is all around us today. Your cordless electric toothbrush and induction stove both work using magnetic induction, the creation of an electrical force when a conducting material interacts with a magnetic field.

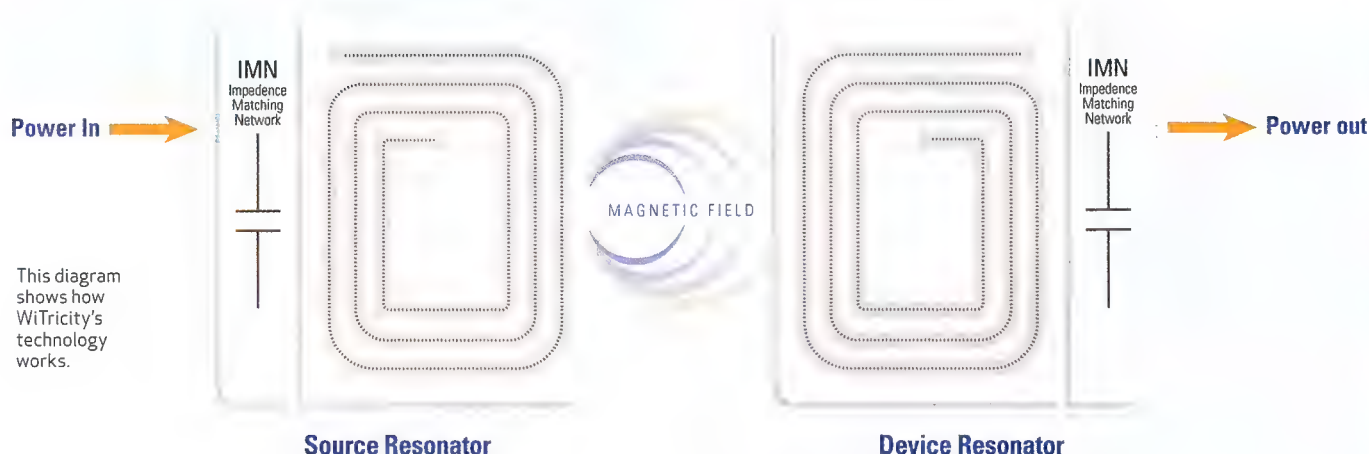
The alternative magnetic field in a coil in the charging station generates a current in another coil in the toothbrush, which charges the battery. In an induction stove, a coil under the cooking plate receives an alternating current, which magnetises the pot, creating movement in the contents and heating them without transferring thermal energy like a glowing red electrical coil or gas flame does.

After that, the next frontier in wireless electricity is distance. If a device only receives a charge by being so close to the coil, you can't move it around, wireless power kind of defeats the purpose (although in some circumstances it's about safety, as it's kept near water, an electric toothbrush is encased mostly fully in non-conductive plastic).

One of the answers to separating the two coils any distance offered by science is magnetic resonance, where the transmitting and receiving coils resonate with the same wave frequency. When you achieve that, you get what wireless power transfer provider WiTricity's Sanjay Gupta calls 'spatial freedom'.

To illustrate, he talks about the way an opera singer can shatter a wine glass from across a packed

Selective energy exchange between efficient coupled resonators.
Tuned and matched source and receiver.



venue. The sound waves from the singer's voice match the frequency of movement of air molecules around the glass, causing them to vibrate so much it's not much different from hitting the glass with a hammer. As long as the frequencies match, the distance is theoretically immaterial.

Plus, as WiTricity told CNN online, it's much safer than the old days of Tesla coils sending huge sparks of static arcs everywhere because transmitters put magnetic fields – not electricity itself – into the air.

WHERE DO YOU GET IT?

We've seen the first generation of magnetic induction charging products of our age already, in the mobile device charging pads you rest your phone or tablet on to recharge them.

Where your toothbrush or electric kitchen knife charger generates magnetic fields in the coils in a specific direction, your phone is charged without having to be so precisely

aligned to the field because the resonant frequency in the base station matches that of the charging apparatus of your device.

Theoretically, you'd be able to leave your phone across the room and it would still charge.

Another recent application is in electric vehicles. As long ago as 2011, New Zealand start-up HaloIPT (now part of Qualcomm) introduced charging pads for electric vehicles using resonance technology like that in mobile charging pads.

Today, the tech can be hardwired in, with a coil right in the floor of your garage or in city parking spaces, where the few inches of concrete or asphalt and the half metre or so between the floor and the underside of the car is no real impediment.

Other new uses and applications are appearing as the field expands. A new system developed at The Korea Advanced Institute of Science and Technology will charge devices from

any distance and direction as long as they're in range of a transmitter, much like Wi-Fi keeps mobile devices connected to the internet now.

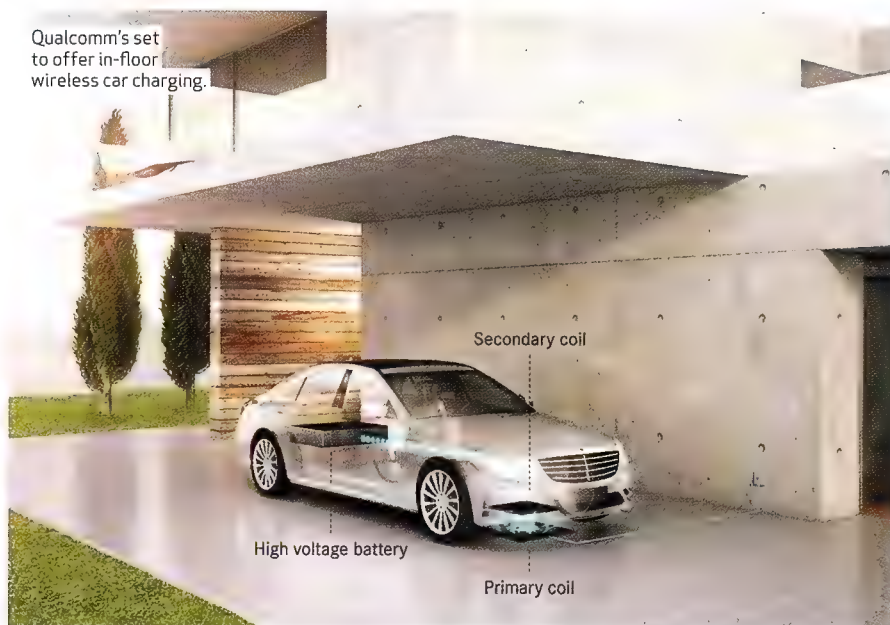
An even more exciting system from the University of Washington uses the Wi-Fi signal itself to power devices. The computer engineers behind the research into what's been called PoWiFi (power over Wi-Fi) found that the ambient Wi-Fi signals from a router came close to the minimum requirements to keep certain low-powered devices alive.

By harnessing Wi-Fi signals not used for data transmission, PoWiFi sends a resonant frequency signal that generates a charge in a coil the same way described above – and all without degrading the data transmission and speed because it's using snippets of data 'downtime' (where there's not a lot of packet transmission) to send the signals.

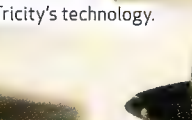
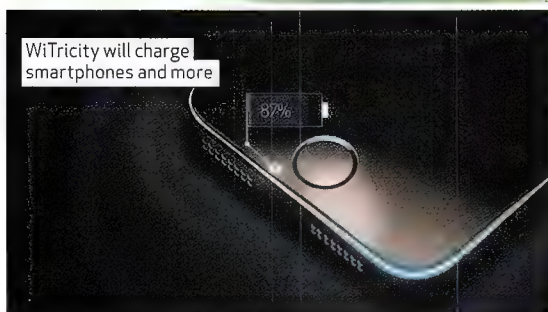
One of the obvious applications of bundling electrical power in with data transmission is in the exploding Internet of Things world, freeing millions of new devices loaded with sensors from the shackles of outlet power or on-board batteries.

Researchers at London's Imperial College have developed a system where drones need never land, hovering over a resonant magnetic field generated from a base station on the ground to recharge while still in flight.

It's only early days, with the drone needing to hover within four inches of the charger. But as a proof of concept, it's inspiring big plans, including charging over the magnetic field generated by power lines, fleets of charging drones that charge other drones or, resurrecting one of Tesla's outlandish ideas, sky-high charging stations connected to balloons – even on other planets to charge devices like the Curiosity rover on Mars.



A transmitter for
WiTricity's technology.

A black, dome-shaped transmitter device, likely for WiTricity's technology. It has a small, rectangular display screen on the side showing a grid of numbers or data. The device is shown in a close-up, slightly angled view.

This leads to the inevitable question — how far can we take wireless electricity? If we can generate a magnetic field large enough to resonate with a distant receiver, can we power large, energy-thirsty tools wirelessly like clothes dryers or robots, maybe even factories, buildings or a whole city?

Absolutely — in theory.

The same infrastructure already exists to deliver electricity to your house or workplace, and the upheaval and cost in retrofitting our entire society to adopt wireless electricity would be steep (to say nothing of intrusive and time consuming). Wires do a perfectly fine job transferring energy very efficiently right to your door.

WiTricity's Sanjay Gupta sees his business as disrupting the wall socket. One of the company's visions (it's active in several industrial sectors) is for everything from stationary devices like TVs to on-the-go tools like your iPad, phone and even PC mice and keyboards to be powered by a resonant magnetic field enveloping your house.

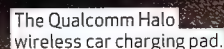
"[We] have this fundamental desire to get un-tethered," Gupta says. "The problem we need to solve is not to make all energy transfer wireless, it's to change the experience of plugging things in." ■

But in a world where the electromagnetic fields generated by mobile phones still concern some people, should we be worried about our houses or workplaces enveloped in a sea of magnetic fields?

But powering every device in the living room, office or a whole city building constantly would need a much more powerful signal, and that can become a problem. Even though the effects of electromagnetic fields on human health is a contentious issue, few argue that there are indeed effects.

If mobile phones are indeed dangerous (conspiracy theorists wait for the day when years of lobbying records and manufacturer cover-ups are revealed), then the kind of magnetic fields we'll need to run higher-powered devices wirelessly won't be as safe as we'd like.

"A good example is wireless vehicle charging — you're not supposed to lie under your car in the middle of the magnetic field charging it, so when the floor is safe — for example, using sensor technology — it can be a little higher powered."



how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

CLOUD

ONEDRIVE APP CONFUSION

The Microsoft Store OneDrive app is one of the many things that particularly confuses me about Windows 10. If OneDrive support is baked into Windows, meaning all your files are accessible through File Manager, then what's the point of the app?

Steve Cox

The Store version of the OneDrive app appears to be targeted to those with Windows PCs, tablets or phones who don't want to keep their OneDrive contents synced with that device. If you have a tablet or PC with limited storage, you may not wish to sync all of your OneDrive content on that device, yet still want to be able to access non-synced files and folders on occasion. The OneDrive app – like so many apps – provides a convenient front-end to achieving this without having to open up your web browser. It's worth noting, however, that browsing your storage can be quite slow based on the speed and type of your internet connection.

Cat Ellis

WINDOWS

FIX PAGING FILE ERROR

I wanted to move my Windows 10 paging file to another hard drive for performance reasons. When I attempted to do so, Windows warned me that I should keep an 800MB paging file on the boot drive in order to record errors. However, since following its advice I keep getting the following error on boot: "Windows created

a temporary paging file on your computer because of a problem that occurred with your paging file configuration". Can you assist?

Rod Turner

It may seem counterintuitive, but what you need to do is ignore Windows' warning and move the whole paging file over to your new drive. In other words, repeat the process you followed previously, but be sure to select 'No paging file' for drive C before clicking 'Set' and ignoring the warning. Then set your other drive as normal.

What seems to be happening here is it appears Windows 10 now moves the location for recording crash information to the same drive as your paging file – this renders the original warning redundant, but, more practically, ensures there's no error on startup either.

Nick Peers

WINDOWS

TO DEFRAG OR NOT DEFRAG?

My new Windows 10 PC has a 512GB solid-state drive. I was advised not to defragment SSD drives, but when I open the 'Defragment and Optimise Drives' desktop app it seems defragmentation is being carried out by Windows. This reveals a hidden partition and my C drive, complete with an 'Optimise' button, but can you clarify exactly what's going on and what settings I should apply?

Albert McCracken

Windows 10's defrag tool is designed

to work with both traditional (Defragment) and solid-state (Optimise) drives. The process of optimising the drive basically ensures that its TRIM function is run which, in turn, basically ensures the SSD's performance (particularly when writing files) is kept at its peak. Albert helpfully included a screenshot of his setup, which allowed us to confirm the drive had been correctly identified as a solid-state drive, which means Windows optimises rather than defrags it. It also confirmed that the default settings meant that Albert's SSD drive is being automatically optimised on a weekly basis, meaning there's no need for him to run the tool manually.

Nick Odantzis

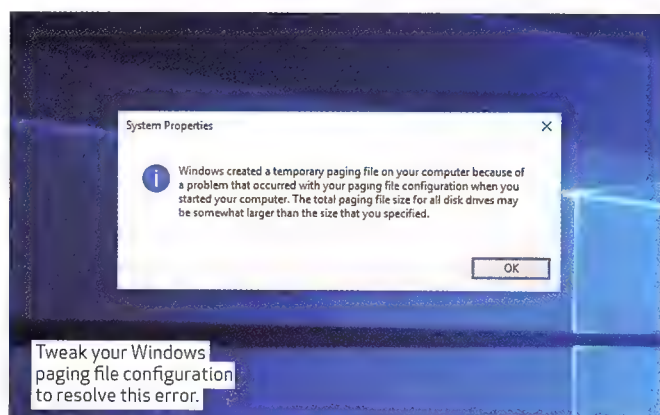
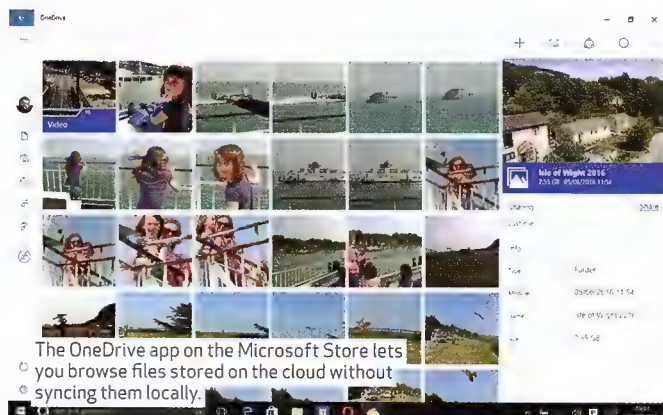
BACKUP

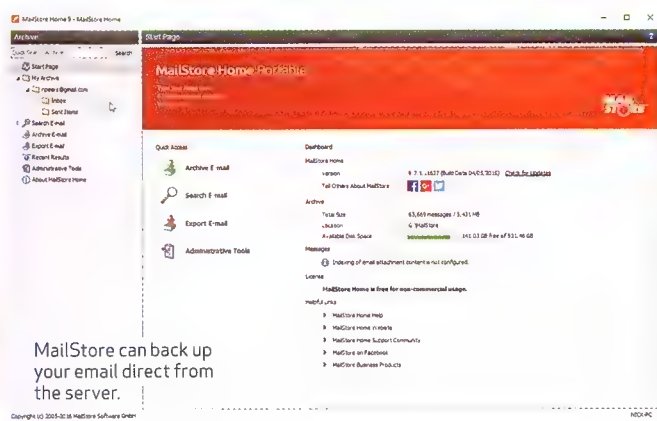
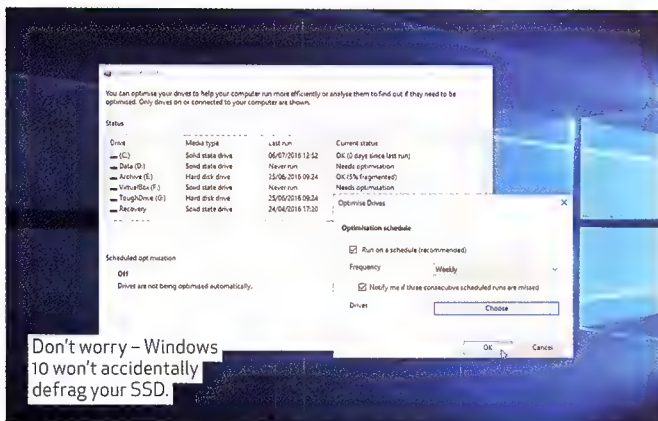
KLS MAIL BACKUP AND WINDOWS 10

I recently read about KLS Mail Backup (www.kls-soft.com/klsmailbackup) and wanted to use it to back up my email, but it doesn't seem to work with the Windows 10 Mail app. How do I back up email from this app in Windows 10? Microsoft admits there is no facility built into Windows 10.

Geoff Laughton

There is no backup tool we know of that will back up the Mail app, but all is not lost. Geoff used the Mail app with two separate mail accounts – Gmail and Greenbee.net – that can be configured to leave copies of the mail on the server. With this in mind, you





can bypass Mail completely and use a free email archiving tool called MailStore Home (www.mailstore.com) to back up mail directly from the server. Use the 'Archive Email' section to set up each account, then either double-click the profile to back up everything from the server or right-click it first and choose 'Properties' to decide exactly what to back up. Once backed up, you can then browse and search your mail offline, plus export it to different applications. If all of this seems like too much effort, then your other option is to install a mail client – we'd suggest Thunderbird (www.mozilla.org) – that is supported by KLS Mail Backup. You could even run this in parallel with Mail – so long as both apps are set to leave copies of mail on the server, you'd then have copies of your email in two separate locations (Mail and Thunderbird) as well as enjoying the security of having it backed up too (KLS Mail Backup).
Nick Peers

SECURITY IS TEAMVIEWER SAFE?

With reports from last year that TeamViewer had been compromised, does this mean we should no longer use it for remote control purposes? If not, what

alternatives are there? Saul Cook

There's probable truth in TeamViewer's claim that those who reuse weak passwords from other sites made it easier for hijackers to get a foothold on some systems. It's entirely possible that if you allow others to remotely control your PC, their lack of security could have put you at risk. Switching to another remote control app like Ammyy Admin (www.ammyy.com) doesn't reduce this vulnerability, so the only practical alternative is to stop using remote control apps altogether.

TeamViewer has tightened security, but the most effective way to block these kinds of attacks is to switch on two-factor authentication. Doing so means your mobile must be physically present whenever you log on to TeamViewer, helping keep hackers at bay.

Nick Peers

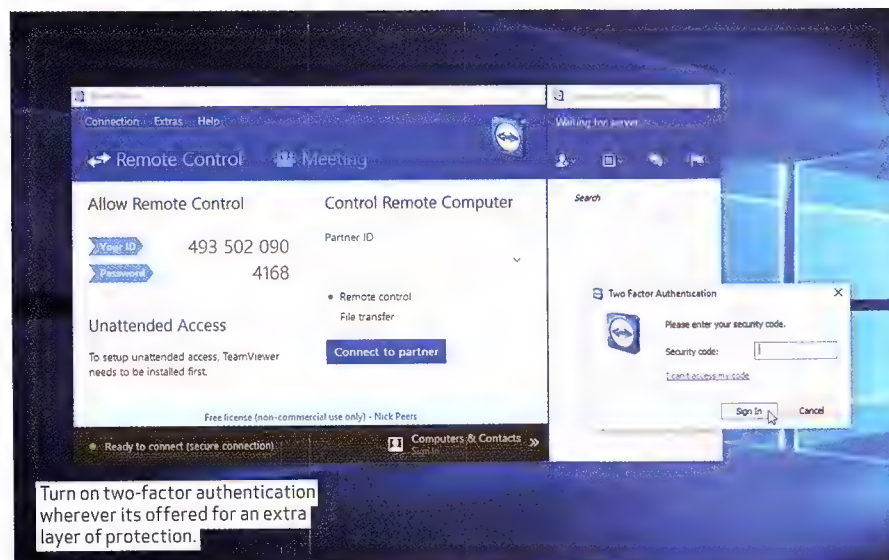
WINDOWS CAN'T INSTALL PROGRAMS

I have a Microsoft Surface Book and have had nothing but trouble with it. I recently reinstalled Windows 10 and since then any program that requires msi.exe to install –

well, doesn't install. The error message tells me it can't find the software installer folder. Seeing as I've already had to reinstall once to resolve problems with this tablet, is there any way I can avoid another full reinstall?
Richard Jones

By the time we contacted Richard he'd bit the bullet and reinstalled Windows 10 again – thankfully this time the problem had finally resolved itself. However, before going down such a drastic route in future, it's worth checking out Microsoft's 'Fix problems that block programs from being installed or removed' troubleshooter app, which can be downloaded from <https://support.microsoft.com/help/17588>. It fixes a wide range of installer problems, so could have potentially saved Richard another long-winded re-install by resolving whatever issue he had with MSI installer files.

Graham Barlow



Fix problems that block programs from being installed or removed

Follow these steps to automatically repair issues including corrupted registry keys that block you from installing or removing programs:

- Select the **Download** button on this page.
- In the **File Download** dialog box, click **Run** or **Open**, and then follow the steps in the **Program Install and Uninstall Troubleshooter**.

Notes

- This troubleshooter might be in English only. However, the automatic fix also works for versions of Windows in other languages.
- If you're not on the computer that has the problem, save the troubleshooter to a flash drive or a CD, and then run it on the computer that has the problem.

Download

What it fixes

- Corrupted registry keys on 64-bit operating systems
- Corrupted registry keys that control the update data
- Problems that prevent new programs from being installed
- Problems that prevent existing programs from being completely uninstalled or updated
- Problems that block you from uninstalling a program through Add or Remove Programs (or Programs and Features in Control Panel)

Runs on

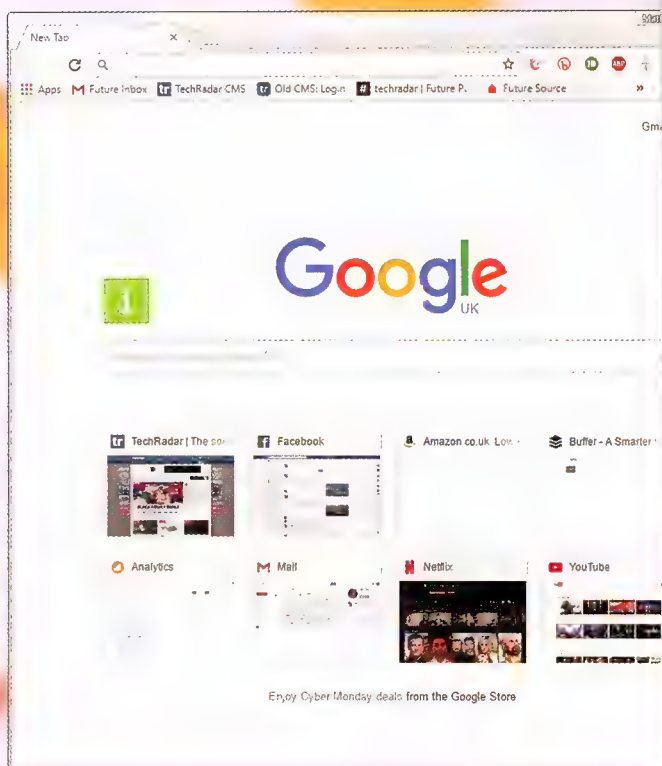
- Windows 7
- Windows 8
- Windows 8.1
- Windows 10

Microsoft offers a specific tool that's designed to fix problems with program installations being blocked.

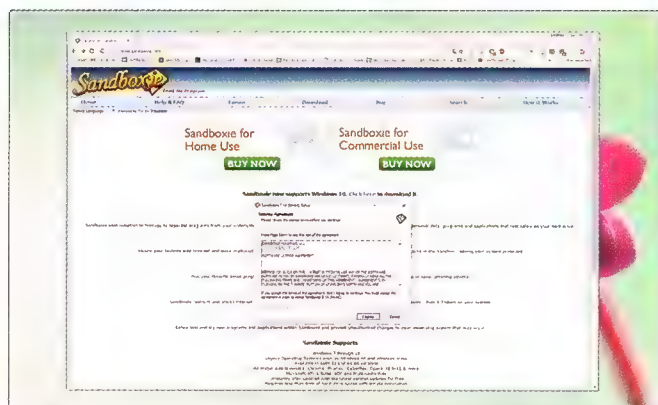
Run Windows apps in a sandbox

Don't want an app to access the rest of your system? Run it in a sandbox, instead. Matt Hanson explains how.

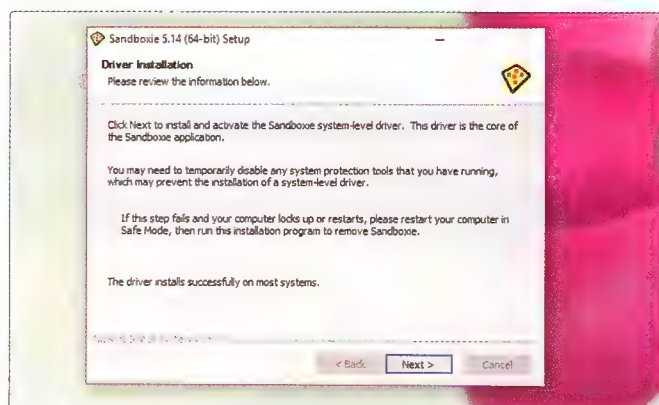
When downloading files from the internet, there's always the risk that you may download a program that's actually a virus. Sometimes, even downloading a safe file comes with additional software you didn't ask for, which installs itself and plays havoc with your system — changing default settings or switching the home page of your web browser, for example. To ensure these apps don't damage your system, you can run them in what is known as a sandbox. This runs them separately from the rest of Windows, which means the program won't access important files and make changes. Running a program in a sandbox is quite advanced, but the Sandboxie app makes it easy.



How to use Sandboxie



1 DOWNLOAD SANDBOXIE
Head to the Sandboxie website (www.sandboxie.com), and where it reads 'Sandboxie now supports Windows 10', click on the 'Click here' app. Once downloaded, open up the .exe file and the installation wizard will begin. Click 'I Agree' on the Licence Agreement page, select the location to install the app, then click 'Next'.



2 INSTALLING DRIVERS
As part of the installation, Sandboxie will ask you to install a system-level driver. This is essential to allow Sandboxie to emulate Windows and run software in a sandbox environment. Click 'Next' to install the drivers — you'll need to have administrator privileges. In the event of something going wrong with the drivers, restart Windows in Safe Mode and uninstall Sandboxie.

1 WEB BROWSER

Click the 'Sandboxed Web Browser' shortcut on your desktop to open your web browser in a sandbox. It will appear and behave just like your normal browser, but when you hover over it, a yellow outline will appear.

2 SANDBOX OPTIONS

Click here to create a new sandbox, or view the folder where downloaded files appear.

3 CONFIGURE SANDBOXIE

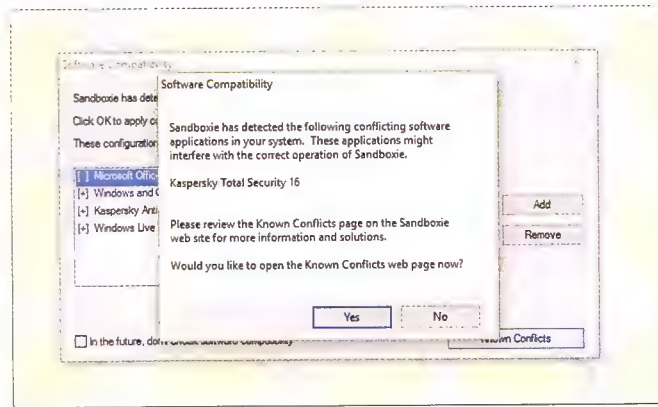
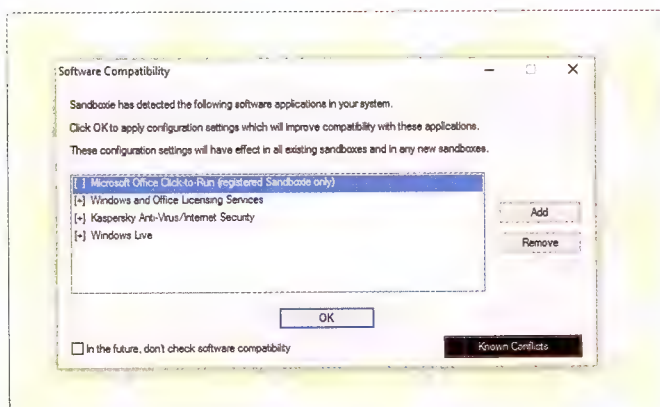
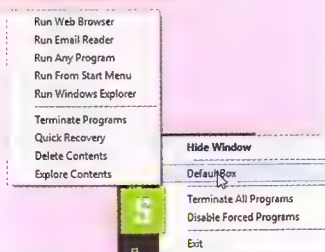
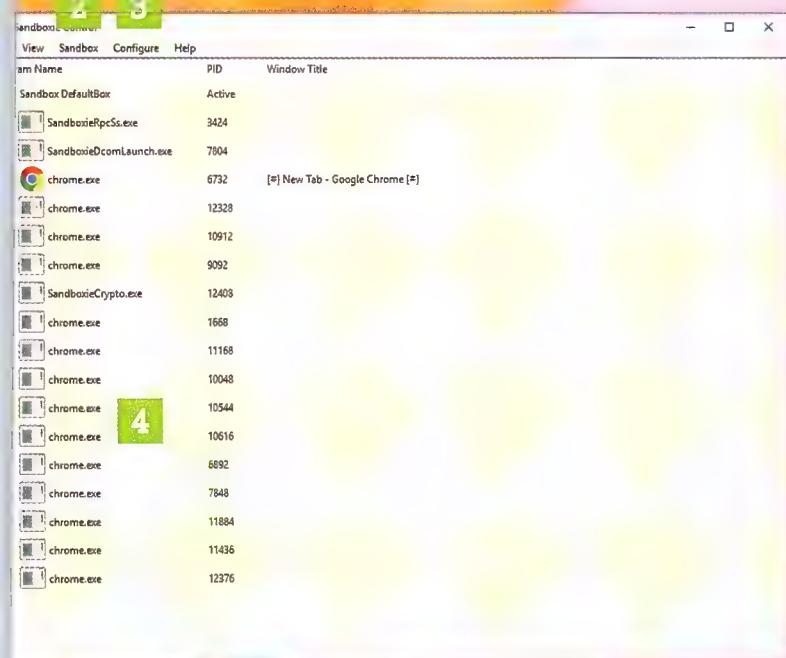
Click here to access configuration options for Sandboxie and the sandboxes that it creates.

4 SANDBOXED APPLICATIONS

In the main Sandboxie window, you can see the applications that you're running in a sandbox. Right-click on a program to access advanced options.

5 NOTIFICATION ICON

Right-click the Sandboxie notification icon in the notification area of the taskbar for quick access to Sandboxie's options.

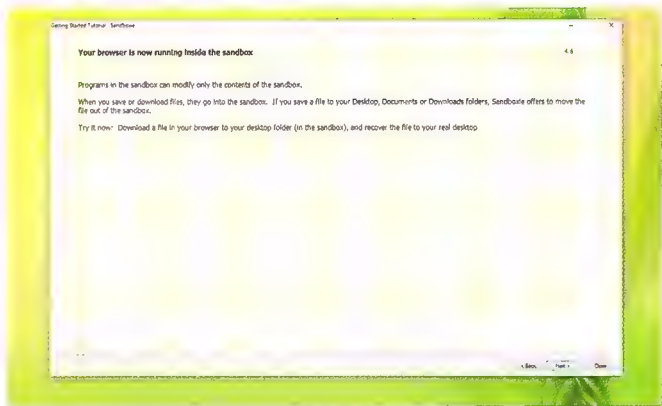


3 RUNNING SANDBOXIE FOR THE FIRST TIME

When you launch Sandboxie for the first time, a window will appear and it may list a number of applications already installed on your machine that need to be configured to work better with Sandboxie. Press 'OK' to allow Sandboxie to configure them, but if there's any you want to leave alone, select them, then tap on 'Remove' to remove it from the list.

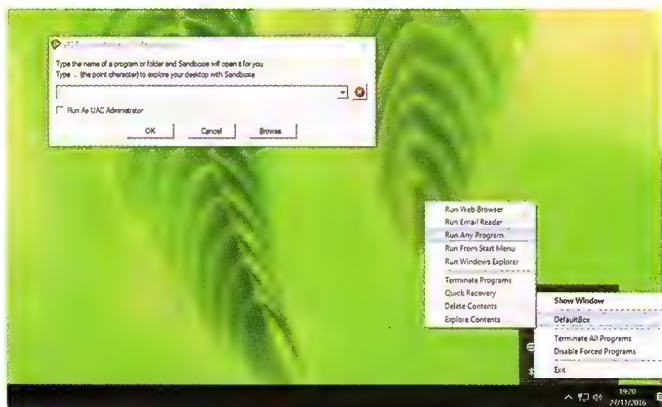
4 KNOWN CONFLICTS

Some apps — such as antivirus software — may not allow Sandboxie to run correctly. If you have any of these programs installed, the 'Known Conflicts' button will flash. Click on it, and a window will appear telling you what programs were found with that conflict. Click 'Yes' to open the Known Conflicts web page and search for what workarounds you need.



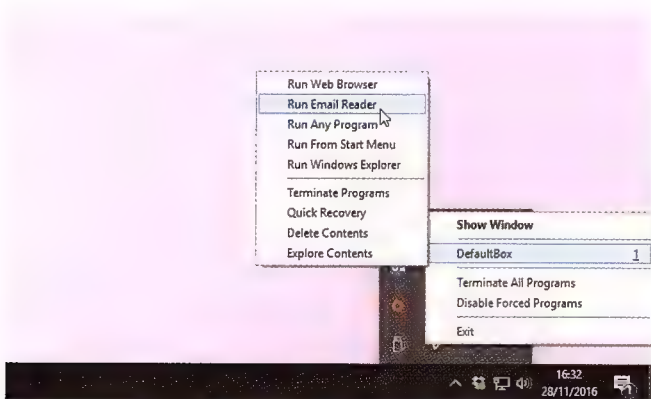
5 OPEN THE SANDBOXED WEB BROWSER

Once Sandboxie has finished configuring itself and other programs, a tutorial will take you through the basics of how Sandboxie works. At the end of the tutorial, you'll be invited to hide the Sandboxie window and open up the sandboxed web browser. You'll see an icon on your desktop for the Sandboxed Web Browser. Click this to open it.



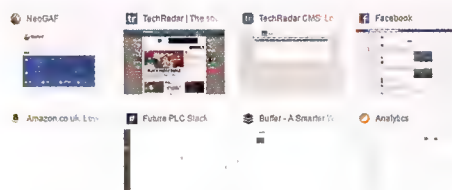
7 RUN PROGRAMS IN THE SANDBOX

If you want to run a program in the sandbox to try it out, right-click on the yellow Sandboxie icon in the notification area. You may need to expand the notification area by clicking the up arrow. Select 'DefaultBox' then 'Run any program'. Now add the location of the program's .exe file into the text box. You can also click 'Browse' to find the .exe file on your hard drive.



9 RUN YOUR EMAILS THROUGH SANDBOXIE

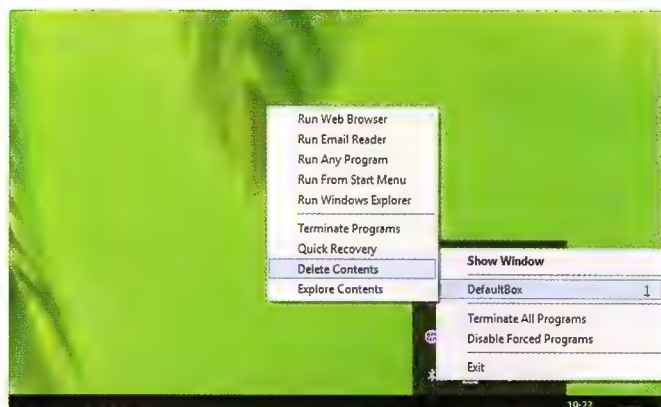
Another regular source of viruses is through emails. To make sure you're completely protected, you can run your email program through Sandboxie. This means you can then open up attachments from emails without worrying about if it's infected. Right-click the Sandboxie icon and select 'DefaultBox', then 'Run Email Reader'.



Enjoy Cyber Monday deals from the Google Store

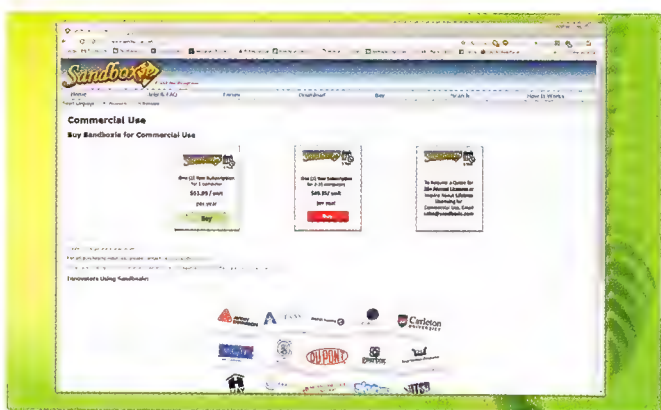
6 USING THE BROWSER

Some websites are infected with viruses that try to download themselves in the background when you visit them. These 'drive by' viruses won't harm you if you use the sandbox. When you download a file using the web browser in the sandbox, the file will be saved in the sandbox, so you can test it before you move it to your main PC.



8 DELETE THE CONTENTS OF THE SANDBOX

Once you've finished downloading and testing files, you can easily delete them from the sandbox, leaving no trace of them on your PC. To do this, right-click on the yellow Sandboxie icon in the notification area and select 'DefaultBox', then 'Delete Contents'. Remember to move everything you want to keep onto your PC before doing this.



10 GO PRO

You now know how to use Sandboxie to keep your computer safe! And while Sandboxie is really great for keeping your home PC safe, it can be also used in a work environment to keep essential files and programs free from infection, but you will need to buy a commercial licence. Go to www.sandboxie.com to find out more.

Lock down your Mac's security

Tighten your Mac's security and ensure files and web accounts stay safe.

When you first set up your Mac, the only security measure that's enforced is that you add a password to your user account. The Setup Assistant makes no mention of extra measures you might want to enable, even though several are built into macOS Sierra. Bear in mind that the features we're about to look at are defences against physical attack, rather than protection against online ones such as security holes in your web browser or social engineering that tries to trick you into ill-advised action.

1 TURN OFF AUTOMATIC LOGIN

It's a risk if your Mac is set to log into a user account automatically on startup: all an intruder needs to gain access is hold down the power button to turn off the Mac, then restart. Automatic login can be disabled under Login Options in Users & Groups or in Security & Privacy in the General tab.

2 OBFUSCATE LOGIN DETAILS

The login window shows account names by default, leaving only passwords to be guessed. Under Login Options, switch to 'Name and password' so both need to be entered to gain access. If you use Fast User Switching, set it to show an icon so the account name can't be read from your screen.

3 RESTRICT YOUR ABILITIES

The first user you create when you first set up your Mac is an Administrator with top-level rights. It's safer to use a Standard account day-to-day, but an Administrator account is needed for system changes. Create a new admin user in the Users & Groups pane, log out, then log into the new account. Select your regular account and untick 'Allow user to administer...' to reduce its rights.

4 REQUEST PASSWORD TO WAKE

By default, waking a Mac from sleep or its screensaver allows access to whatever account was left signed in. Under General in the Security & Privacy pane, turn on the option that requires a password to wake, and set how soon it's needed. Anything longer

than five seconds presents a risk if your Mac is left unattended. It's more convenient than logging out every time.

5 TIGHTEN KEYCHAIN SECURITY

Your account password also protects your Keychain, which gives you access to Safari's AutoFill feature, for example. The Keychain can be given its own password so that separate consent is needed. To do this, simply open Keychain Access (you'll find it in 'Applications/Utilities'), right-click 'login' in the Keychain list and then choose 'Change Password...'

6 LOCK THE KEYCHAIN

In the same menu as mentioned in the tip above, choose 'Change Settings...' for options that lock the Keychain when your Mac goes to sleep and after a period of inactivity. In Keychain Access's preferences, you can add an icon to the menu bar to display the Keychain's status and manually lock it. When the Keychain is locked though background system services may prompt you for access.

7 AN UNPLUGGED HOLE

Without a firmware password,

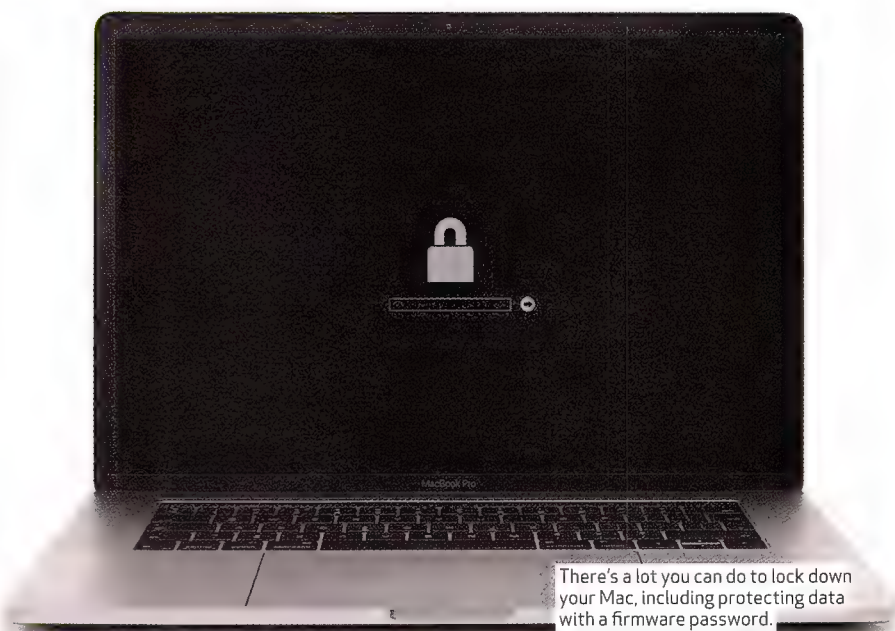
Recovery mode gives anyone the ability to reset any account's password by typing "resetpassword" in Terminal. The Keychain password is unaltered by this, so an intruder won't be able to read website logins in Keychain Access or Safari, but they will be able to access files stored locally.

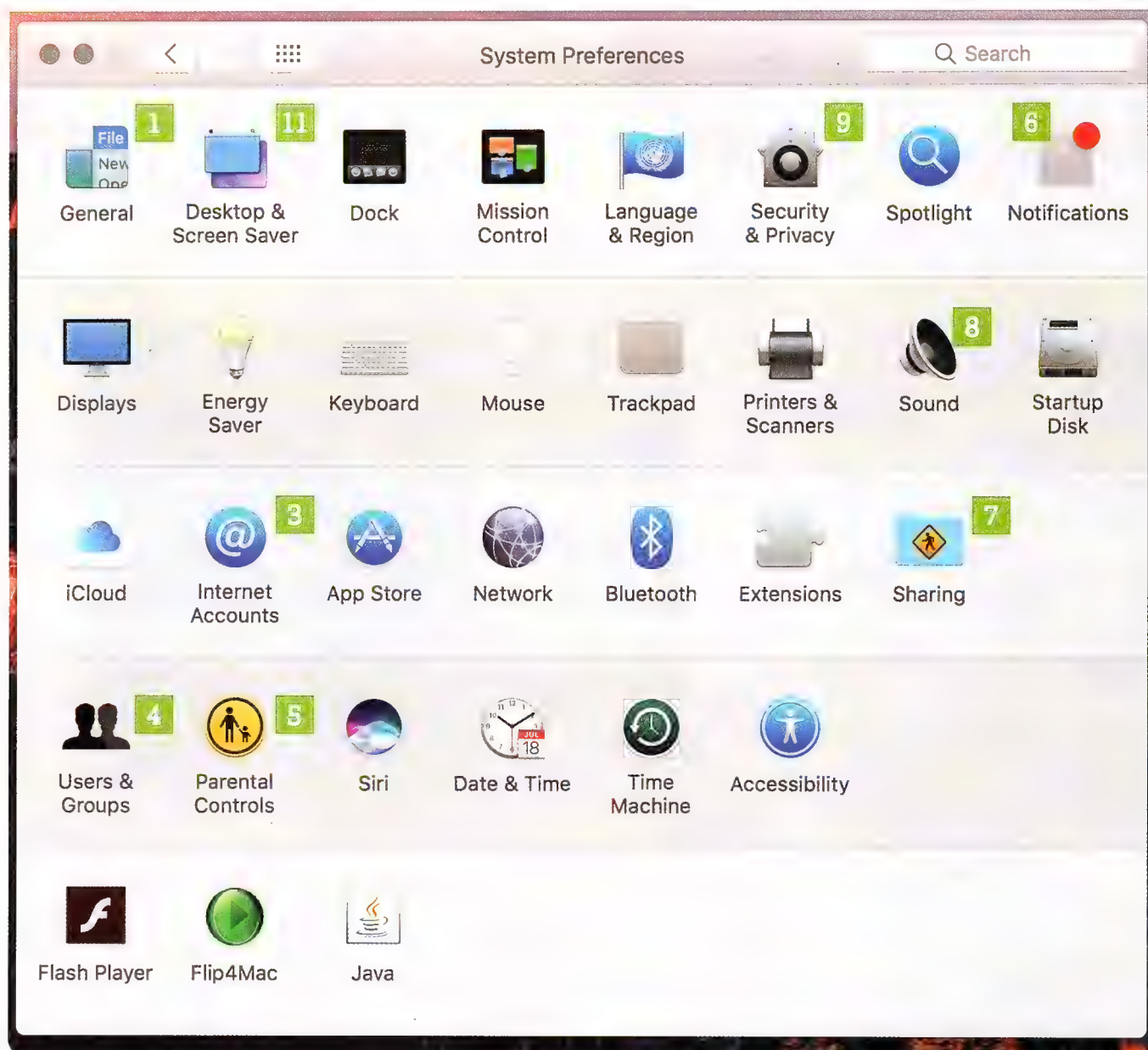
8 SET A FIRMWARE PASSWORD

Restart your Mac and hold 'Command-R' at the startup chime to start in Recovery mode. When it finishes loading, go to 'Utilities > Firmware Password Utility' and set a password. Make sure you don't forget it – you'll need it on occasions such as restoring from Time Machine, and to use other startup key combos.

9 P*55WRD TIP

A strong password is one that can't be guessed either by a person or figured out by a program, and ideally uses a combination of letters, numbers and symbols. Be careful using symbols, though, as the keyboard layout at the password box may put them on unexpected keys. Also avoid the temptation to reuse the same password for everything! ■





Advanced macOS customisation

Master System Preferences to get your Mac working your way.

The System Preferences window is your Mac's nerve centre: if you want to tweak how something works in macOS Sierra, this is where you'll usually do so. You'll find System Preferences in the  menu. It's laid out in rows of easily identifiable icons with a brief name description given underneath. Clicking each icon opens what's known as a 'pane' with the available settings within.

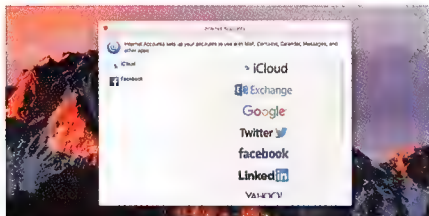
When viewing a pane, clicking the button with a grid of dots at the top will take you back to the main window, or you can use the back and forward buttons at top left, similar to those in Safari. Here, we'll show you the essential options that every new Mac owner needs to check out, such as security and internet accounts, and others that will simply help you to personalise your Mac.

COLOURS

To alter the colour that appears when you highlight text, click General and make your choice from the second drop-down menu, labelled Highlight Color. If you're not happy with the standard hues, why not choose your own? Simply select the 'Other...' option, which will open up a colour picker wheel. The top drop-down menu enables you to switch the standard macOS blue colour to graphite (or grey). This is the colour you see in scroll bars and whenever you click menus.

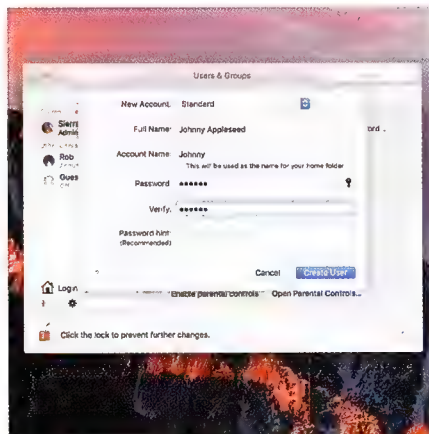
2 STOP DOZING OFF

To prevent your Mac going to sleep after a short time, open up the Energy Saver pane. This contains sliders where you can set how long your computer must sit idle before it goes to sleep. If you have a Mac laptop, you can set different times depending on whether it is plugged into the mains or running off its battery. The Energy Saver pane is also where you can schedule your Mac to start up or shut down at a specified time. Note that this is separate from the screensaver, which you configure in the 'Desktop & Screen Saver' pane.



3 INTERNET ACCOUNTS

macOS Sierra makes it easy to set up accounts for all your favourite email services and social networks, with many settings preconfigured for you. All you have to do is add your login details and Sierra will do the rest. To add an account, click the '+' button on the bottom left of the pane and then choose the service you want to set up. You can also set up accounts manually using the Add Other Account option.



4 EACH TO THEIR OWN

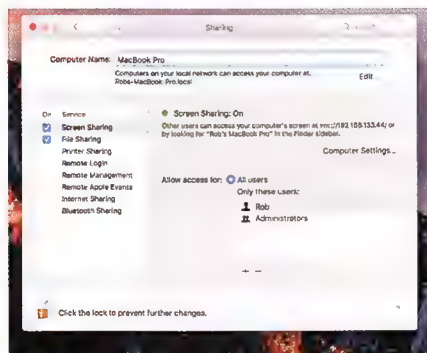
Everyone who uses your Mac can have their own account, enabling them to set their own desktop background and work in their own environment, without having access to your setup. After you set up multiple accounts, your Mac starts up with a login screen, and accounts can be switched at any time within Sierra. It's best to use a Standard account most of the time and log in as Administrator when needed. To apply Parental Controls, select an account and then tick 'Enable Parental Controls'. See Step 5 for more details.

5 PARENTAL CONTROLS

Do you want to stop your children opening certain applications or visiting particular websites? Parental Controls is where you can help ensure that they stay safe. It even attempts to block adult content automatically, or you can set a list of banned sites manually. You can also limit how long your children can spend on your Mac, prevent them changing their password and hide profanity in the Dictionary app.

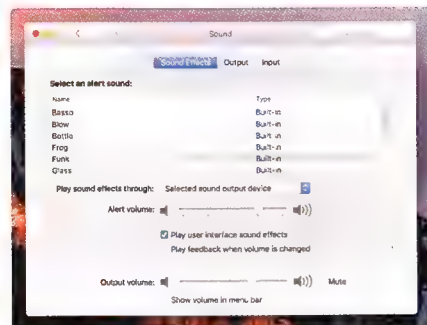
6 NOTIFICATIONS

Mirroring the iOS equivalent, macOS Sierra has a Notification Center. Click the button at the far right of the menu bar and you get two tabs: Today shows widgets you can arrange and install; and Notifications lists alerts from apps, such as missed calls and Facebook messages. In the Notifications pane, you define how and when alerts appear.



7 SHARE AND SHARE ALIKE

Sharing files over your home wireless or wired network is easier than you may think. The Sharing pane contains a list where you can switch the various services on and off, including screen, file and printer sharing. If you're not sure what a particular option does, click its name and an explanation will appear top right. Below this, you'll see further settings — usually, who you'd like to give access to. See page 90 for more.



8 SOUND SETTINGS

Most of the time, the volume keys on your Mac's keyboard are all the audio control you need, but the Sound pane offers that little bit more.

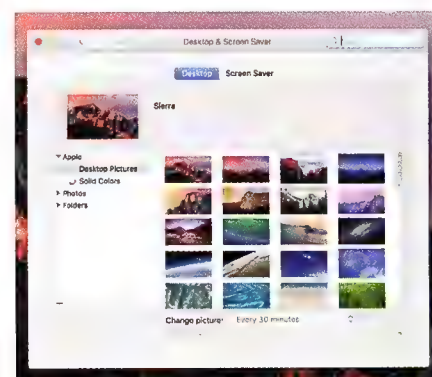
You can select input and output devices, which you'll need to do if you use your speakers during the day but want to switch to headphones in the evening. Another useful setting to note here is the audio input level — tweak this if you use a microphone with Sierra's speech recognition features, for example.

9 LOCK IT DOWN

Even if you're the only person who uses your Mac, it's worth keeping your machine safe. Use the 'Security & Privacy' pane to require a password to wake your Mac from its screensaver, to disable automatic login, and to set up the FileVault encryption system. It may also be worth setting up the firewall (but note that it may prevent some apps from working unless you specifically grant them network access). Manage this by clicking the Firewall tab followed by the 'Firewall Options...' button.

10 SEARCH BAR

If you're not sure where a particular option lives, try typing some keywords into this search bar. A drop-down list will show you the named preferences that match, and as you use the up and down arrow keys to move through that list, you'll see the relevant pane's icon highlighted. Click it to jump to the correct pane. Note that you can also search System Preferences' panes using Spotlight. Press command plus the spacebar and type your keywords — the results will appear in the System Preferences category.



11 CHANGING DESKTOP

Bored with the background image on your desktop? Set an alternative in the 'Desktop & Screen Saver' pane. In the left column, pick a folder that has images in it, and tick 'Change picture' below. Use the drop-down menu to decide how often it changes. Avoid the five-second and one-minute options, as the constant swapping just gets distracting — if you want to look at your photos like this, try a slideshow! ■

Master 3D Touch on iPhone

Unleash the extra power of your iPhone 6s or 7's pressure-sensitive screen with Alan Stonebridge.

The screen in the iPhone 7 and 6s series (but not the SE) can sense the amount of pressure you apply to it, enabling apps to react differently than if you simply tap on an item. Apple calls this tech 3D Touch and uses it extensively throughout iOS to provide you with quick routes to many useful features.

On the Home screen, 3D Touch provides shortcuts – or Quick Actions, as Apple calls them – to popular features in many apps with just a firm press followed by a tap. In fact, you don't even need the tap; just press your finger on an icon, slide it to the Quick Action you want and then let go to choose it. Sometimes, you'll also be shown a widget containing key information from the corresponding app, such as current conditions from Weather, the last item you worked on

in Notes, and up to four of your most recent Memories in Photos. (Note that items in widgets have to be tapped.)

3D Touch also provides a more powerful experience when selecting text in apps like Notes and Pages. It enables you to move the insertion point around a document while keeping your fingers over the on-screen keyboard rather than obscuring the text with them and having to rely on iOS's magnifying glass effect and find the desired finishing position. 3D Touch also enables you to very quickly extend your selection by additional whole words, sentences or paragraphs.

FEELING THE PRESSURE

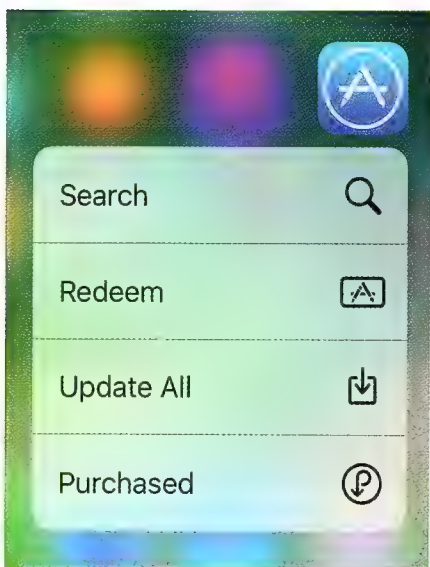
Though we say text selection with 3D Touch is powerful, it can take a few attempts to master applying different levels of pressure to trigger its effects

and become comfortable with it. If you find 3D Touch over- or undersensitive, bear in mind that its responsiveness can be altered; you're shown an option to tailor it when you first set up your iPhone, and it can later be adjusted to one of three levels in 'Settings > General > Accessibility > 3D Touch'.

After trying out the things 3D Touch can do for you, there is, of course, a chance that you'll dislike some aspects of it. Sadly, unlike being able to turn off certain gestures on a Multi-Touch mouse or trackpad on your Mac, iOS provides no way to selectively disable some of 3D Touch's behaviours. So you must get used to accidentally triggering some features and try to adjust the firmness of your presses over time, or if that doesn't pan out, disable 3D Touch altogether in the Settings page mentioned above.

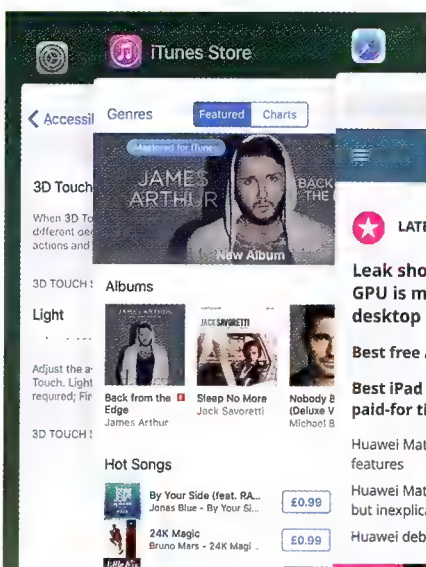
How to

Use 3D Touch system shortcuts



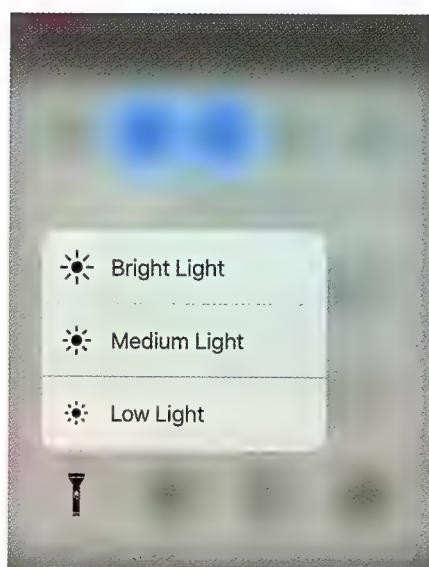
1 QUICK ACTIONS ON APPS

For many apps, a firm press on their Home screen icon reveals a list of actions you can take. In some cases, it also shows a widget with info or additional actions; if you refer to a widget often, there's an option on it to add it to iOS's Today view.



2 SWITCH BETWEEN APPS

Instead of double-clicking the Home button to open the app switcher, press firmly on the left edge of the screen. Alternatively, press firmly while swiping almost all the way to the screen's right edge to go back to your previous app.



3 CONTROL CENTRE

Apply 3D Touch to an icon in Control Centre's bottom row for shortcuts: pick from three flashlight brightnesses, start a 1, 5, 20 or 60-minute timer, copy the last result from Calculator, or jump into photo, selfie, video or slo-mo camera mode.

How to

Take a closer look at things



Open in New Tab

Add to Reading List

Copy

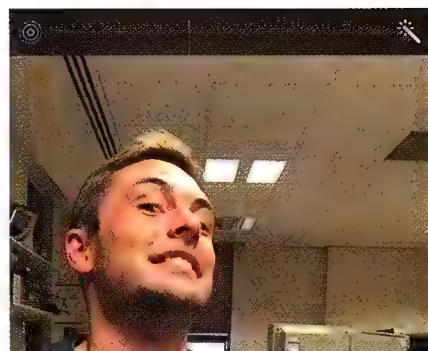
have to start over.

Big mistake! What you do is you follow Simple and Sinister!

This program combines just two exercises - Perfect for when you need to be more efficient with your use of time. These two exercises will take care of your: Streng

Delete

Mark as Read



1 PEEK AND POP

In many apps, pressing lightly on an item (say, a message in a mailbox in Mail or a link in Safari) peeks at that content. If the item isn't what you want, let go to close it. Otherwise, press harder to pop it open, or swipe up for available actions.

2 NOTIFICATIONS

Tapping a notification's banner takes you to the relevant place in an app, but you can deal with an item where you are by pressing firmly on it, and then swipe down to clear it. This also works at the Lock screen and in Notification Centre.

3 PLAY BACK LIVE PHOTOS

If you take or receive a Live Photo (which includes a short amount of video either side of the still image), you can tell it apart from regular pics by an icon of concentric circles when editing it. Apply 3D Touch to a Live Photo to play it.

How to

Work with text using 3D Touch

account and on the same Wi-Fi network. When Apple TV wants you to enter some text, a notification will appear on your iPhone; apply 3D Touch to it and the on-screen keyboard will appear. This can be

search terms and passwords on your TV, you needn't install the Apple TV Remote app. In Settings > Notifications > Apple TV Keyboard, ensure notifications are allowed, and ensure your Apple TV and iPhone are signed in to the same iCloud account and on the same Wi-Fi network. When Apple TV wants you to enter some text, a notification will appear on your iPhone; apply 3D Touch to it and the on-screen keyboard will appear. This can be

screen keyboard will appear. This can be helpful even if you have Apple TV Remote installed, as you don't have to open it.

Tip 100

iOS 10 extends the ability for you to manually block calls from numbers so that third-party apps can alert you on the incoming call screen that a call is thought to be from a spam or scam caller. You can even block such callers altogether. The free app Hiva is one example of this, and it

1 MOVE WITHIN TEXT

To select a range of text, press firmly on the on-screen keyboard and its keys will go blank. Keep your finger on the screen and slide it around to reposition the insertion point in the document or form above, relative to your movements.

2 START A SELECTION

After positioning the insertion point, keep your finger on the screen and press firmly again to select the word it's within. Slide your finger to add additional words. After lifting your finger, you can access the options bar by tapping your selection.

3 BUILD A BIGGER SELECTION

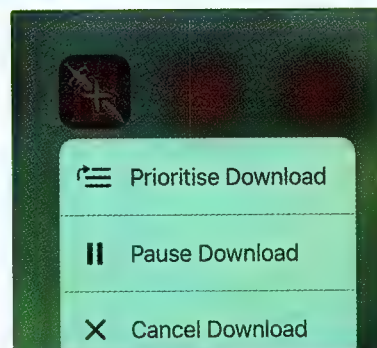
Position the insertion point, press firmly twice in quick succession to select the sentence it's in, then slide your finger to extend the selection a sentence at a time. Or press three times to select and then grow your selection in paragraphs.

Other 3D Touch shortcuts

A few more useful places you can press firmly

3D Touch can help you in even more ways in iOS and many third-party apps. On the Home screen, a firm press on a folder reveals a shortcut to rename it and direct routes to apps inside that have notifications waiting. Press the cross to the right of a heading in Notification

Centre for a shortcut to dismiss all items. In Reminders, press on an item to set a location or time at which to be nudged about it. When restoring from a backup or downloading several apps, press on an app's Home screen icon to pause/resume, cancel or prioritise its download. ■



Dual boot: Set up two OSs

Afnan Rehman dives deep into the world of dual-boot systems to bring you the simplest solution to using your favourite Linux distro plus another OS.

We live in a world where multiple operating systems hold a share of the desktop market and applications aren't always available on every platform that you want, it's often necessary to have more than one OS available ready to boot. Virtual machines offer only a partial solution to this problem as do compatibility layer technologies such as Wine. The solution is to dual-boot two operating systems on the same machine.

The boot managers of modern-day OSes can manage multiple systems and allow the user to choose which one to boot at startup. This way, you can have Windows OS and a Linux distro, so that you can keep the beautiful experience that is Linux while also accessing applications that still only work well on Windows for work or play. (Not every game supports SteamPlay on Steam for Linux, although we're getting closer). In this tutorial, we'll focus specifically on dual-booting a Linux distribution (distro) with Windows. We will be using Ubuntu. However, the steps in this tutorial can be adapted to other Linux distros, too.

First, let's talk a little bit about why we dual boot. There are many reasons people pursue a dual-boot solution, the key reasons being performance and compatibility. As most users will tell you, it's best to run things natively with access to the computer's hardware resources. The fact is, virtual machines will severely restrict the amount of resources that you can use. When you implement a dual-boot system, you're able to boot as if Linux is the main OS

and Windows wasn't there and vice versa. That gives you access to all the processing cores, all system RAM and all expansion cards that the computer has to offer, making it easy to run intensive programs without slowdown. You also get access to all disks and externally connected devices such as USB devices at full speeds (as long as the OS supports them, of course).

HOW DUAL-BOOTING WORKS

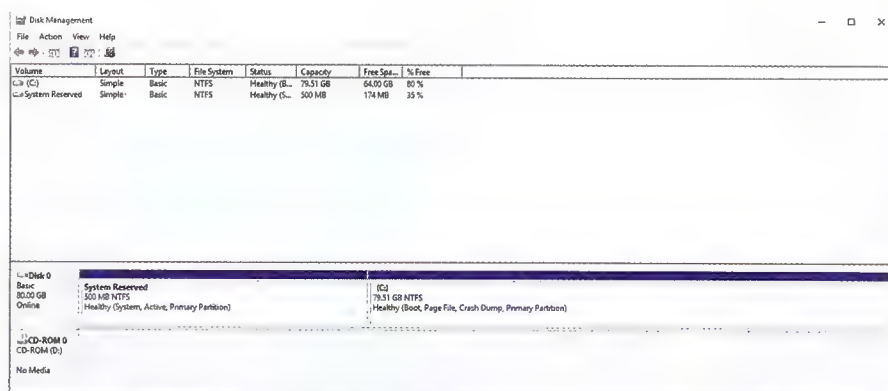
For the sake of brevity, we will assume you are able to install Windows without a detailed explanation. It's safe to say that, if you've ever installed a Linux distro, you are more than ready to install Windows on your own. If you're a newcomer to Linux – Welcome! – and you're likely to have Windows installed on your current system (given that the Windows family still has around 90% of the market) and can proceed directly to creating a dual-boot system as a fresh reinstall of Windows isn't required. If you haven't tried installing Windows before, the process is simple and there are many guides online to help you. The installation media is usually sold on a disk or USB drive and can be often purchased online or in store. Once you insert the media and boot the computer, a series of steps will



guide you through the installation. The version of Windows that you choose to install shouldn't matter, whether it's Windows 7, 8 or 10. The type of program that's used to get the system started after turning it on, either legacy BIOS or EFI boot, may matter in some cases but on most modern systems, this won't cause any major issues.

Let's get some basic terminology out of the way. EFI stands for Extensible Firmware Interface, and most modern system partitions are in this format, which adheres to the UEFI (Unified Extensible Firmware Interface) standard. UEFI replaces the Basic Input/Output System (BIOS) that most PC devices used before. This is important mostly for more advanced users who wish to manually set partitions for more customised setups. Since most modern systems use UEFI, we'll work on the assumption that you will, too.

Each hardware manufacturer has a different implementation of UEFI and each has its own unique quirks. Most have the same basic functions and structure, which allow for the installation of different operating



The Disk Management tool provides an easy to understand graphical interface for partitioning and managing storage on all disks that the OS has access to.

What to do when you mess up

Should you need to repair the Ubuntu bootloader after trying to install a dual-boot system, the Ubuntu wiki has some great instructions for helping to repair the bootloader. The link is help.ubuntu.com/community/RecoveringUbuntuAfterInstallingWindows. The recommended way would be to use an Ubuntu live CD or USB that you created when first installing Ubuntu. The simple graphical way is to insert your disk or flash drive, reboot the computer and boot into the live CD environment. From this environment, you can choose the Boot Repair tool which is built into the Live CD. The boot repair guides you through solving more frequent problems, such as

those associated with dual-boot and can also generate error reports that you can share on forums or email to your genius friends who are more Linux savvy to get help with the issue. For recovering Ubuntu, you can click 'Recommended Repair' and allow it to work its magic. Then all you have to do is reboot and the usual boot menu should appear. If not, you can hold left Shift key while booting to select between the two operating systems. You can also try to repair it by opening a terminal. When you are given a standard Bash prompt, type:

```
# sudo grub-install /dev/XXX
```

Replace 'XXX' with your Ubuntu install device (eg. /dev/sdb).

systems. However, Different UEFIs can manifest major problems for some and instant success for others. Different button settings, boot menus, and startup sequences can cause problems when you are trying to mess with the boot sequence. It's best to research your manufacturer's UEFI manual beforehand and familiarise yourself with the settings before you try to change anything. Most system boot sequences will feature a splash screen where you can press a function key to gain access to boot settings menus (for example, it's F9 for HP, F12 for Dell and Lenovo, F8 in Amibios and F11 in an Award BIOS) and you'll need to know which key it is to open which menus and which settings to change. Knowing these things beforehand can save you a lot of headache should the need for troubleshooting arise.

PARTITION STANDARDS

You'll also hear the acronyms GPT and MBR thrown around. These terms relate to how partitions in the hard drive are organised and recorded. MBR, which stands for Master Boot Record, refers to the information stored in the first sector or partition of the hard drive that identifies how and where an operating system is located so that it can be loaded into the computer's main storage or RAM.

GPT, which stands for GUID Partition Table, is similar in function to MBR in that it stores partition information for the hard drive. This information includes where the partition starts and ends so that the OS knows which sectors belong to which partition and which ones are bootable. MBR, which was first introduced back in 1983, can only handle drives that are up to 2 terabytes in size and can support up to four partitions per drive. GPT is a newer standard that has been gradually replacing MBR and handles drives that are far larger and allows for a nearly unlimited amount of partitions. If you have Linux the GRUB bootloader, which handles OS booting just like the Windows boot loader,

is often stored in the MBR or GPT. It's important to note that Windows can only boot a GPT drive on a UEFI-based machine. All current versions of Windows, Linux and Mac OSX support GPT and it's generally recommended to use this scheme on any new installs for the sake of compatibility and to avoid issues that MBR might bring.

There are benefits and drawbacks to either installing Windows or Linux first and every system is different. In this guide, we will be taking you through the process having Windows installed first. It's possible to install Ubuntu first, but there are far fewer issues when having Windows installed first, as the Linux GRUB bootloader can adapt easily to accommodate Windows. In contrast, the Windows bootloader will almost always disregard the presence of another existing OS, often overwriting the existing bootloader and rendering the other OS useless until it's repaired.

It's important to note that, while most of Linux distros are good at handling dual-boot situations, there's always room for something to go wrong. We highly recommend performing a backup of any existing data to a separate storage device just in case. Any files, settings or applications can be backed up in a variety of ways that will allow you to pick and choose what to save for later. It would be best to save this backup on a separate physical device, such as a different hard drive, a different computer or possibly cloud storage if you have enough space and a fast enough

connection. The simplest way to back up everything you need to back up is to make a recovery disc which will back up Windows itself and set up a File History backup to take care of personal files. There are wizards located in the Control Panel that will guide you through both of these backup processes. The recovery disc will help you restore Windows system and boot files in case something goes wrong with the operating system. File History will automatically back up personal files to a designated device in case the worst comes to pass and your entire drive partition gets corrupted.

Now that you understand the basics, let's get to work. The first thing you'll need to do is choose your distro of Linux that you want to install. For this tutorial, we're using Ubuntu 16.04. The most important thing you will need to start is a copy of Ubuntu live CD on a USB flash drive or compact disc. You can download your preferred version of Ubuntu from its website at www.ubuntu.com/download. Here you can download an ISO file that you can use to create a DVD or bootable USB flash drive. We recommend creating a bootable flash drive as it's more versatile than a DVD, especially with optical drives getting phased out of many newer systems to save space, weight and power. Once you have a flash drive made, you can move on to getting your partitions in order to prepare for the installation.

Of course, now you will only be able to resize the Windows partition if there's a decent amount of available

C:\Windows\system32\diskpart.exe

Microsoft DiskPart version 10.0.10240

Copyright (C) 1999-2013 Microsoft Corporation.

On computer: DESKTOP-ATKJKV9

The diskpart tool allows you to accomplish partitioning and storage tasks with a command line interface for more advanced users and those who might wish for more custom settings.

Shrink C:

Total size before shrink in MB:

81417

Size of available shrink space in MB:

64418

Enter the amount of space to shrink in MB:

64418

Total size after shrink in MB:

16999

i You cannot shrink a volume beyond the point where any unmovable files are located. See the "defrag" event in the Application log for detailed information about the operation when it has completed.

See "Shrink a basic volume" in Disk Management help for more information

The shrink volume dialog box in Disk Management allows you to shrink a partition size, and also warns you if your desired shrinkage is too small.

Shrink

Cancel

space on it, so make sure you have room before you commit to undertaking this project. If your computer is running multiple hard drives, you also have the option of installing Linux on an entirely different drive, leaving your Windows partition untouched. Now before you run out and purchase a brand new hard drive, I'll remind you that the two installations are perfectly capable of running in harmony on different partitions of the same physical drive.

PARTITIONING METHODS

There are a few ways to handle partitioning, so I'll explain the one that assumes you have Windows already installed. If you already have Windows installed, the easiest method is to just use the diskpart utility built into Windows to help with this process. Every drive is different, and it's likely you'll have multiple partitions already existing on the hard drive, such as recovery, OEM and primary etc. Be careful resizing or deleting these partitions as messing with the wrong one will lead to major issues. Usually, the partition labelled 'Primary' is the largest and is where most of your files and data are held. Any partitions labelled 'System' or 'OEM' should not be modified at all, as those hold Windows system files and cannot be changed, lest you risk the entire system being corrupted. The Primary partition could be resized to give you space for your Linux installation. The easy way to do this is to go into the Disk Management application, find your drive with the primary Windows installation, right-click the partition and select 'Shrink Volume'. After that, just follow the onscreen instructions and you're good to go. Now you'll see a section of the drive with a black bar above it

labelled as 'Unallocated'. This is where your shiny new Linux installation will go. Alternatively, if you're feeling brave you can lose any partition named 'Recovery' and install there. However, make sure you know what you're getting yourself into when you do this.

Now, you can restart and boot from a USB or disk into the Ubuntu live CD by holding down the Shift key while rebooting. On booting, hit the appropriate function key to load up the boot menu, where you can select which device to boot from. Find your flash drive and hit the Enter key to commence the boot process. You'll be loaded into the Ubuntu live CD environment with its basic feature set. Here, you can start the installation process.

Now follow the onscreen instructions to install Ubuntu. Make sure to choose options that would allow for the Ubuntu install to exist alongside the existing Windows installation. Don't try to overwrite it, because that would be disastrous. This step will involve you as the user deciding how much space to allocate for your Linux installation. You've already set aside space for the Ubuntu installation in Windows Disk Management, but you also have the option to use more or less space depending on how you want to do things. In Ubuntu, there are two ways to install alongside Windows. First, there's an option labelled 'Install Ubuntu alongside Windows' which will handle everything for you. Some other Linux distros, such as those using Calamares installer, offer similar options to simplify the process. Otherwise, you can also make and resize partitions using the installer. If you choose this route, you can select 'Something Else' when prompted for

installation type. You can resize the partitions based on your needs and use case. If you're mainly using Linux to experiment, you may not need as much space as if you were, for example, heavily invested in Linux gaming or dealing with other large amounts of data. Make sure that the boot loader remains the Windows Boot Manager.

The installation process itself will vary depending on the Linux distro that you want to use. For Ubuntu, the process is a fairly simple step-by-step walkthrough. You can choose to install updates during the installation, however, you can skip this if you have a poor internet connection or just want to install them later. At the very end, you'll be asked to restart.

At this point, you're done and can start using your Ubuntu Install. Switching between OSes would involve a simple reboot. When booting you'll be given the option to load either Windows or Ubuntu, usually with a default option that will automatically boot after several seconds. If you're not receiving these options, try some basic troubleshooting by retracing your steps.

Sometimes, you may find that you need to remove the Linux install for whatever reason. When removing Linux from the dual-boot process, you must be very careful so as not to break your bootloader and, in turn, create a massive headache and possibly render the Windows install unusable.

REMOVING LINUX

To start, you'll need your Windows installation or recovery CD or an Ubuntu live DVD. To remove the GRUB bootloader, open the command prompt from the installation or recovery media environment. Next, type:

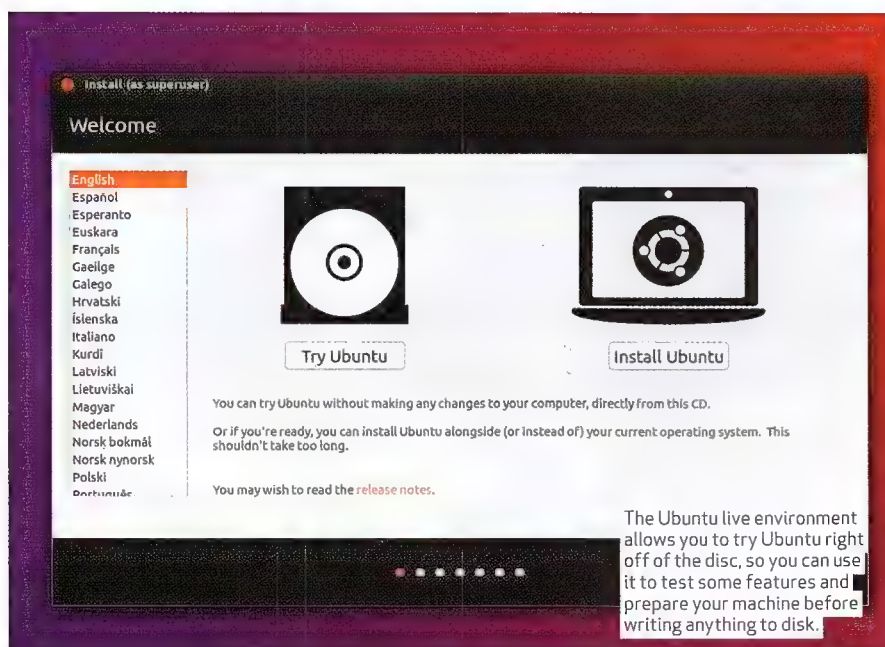
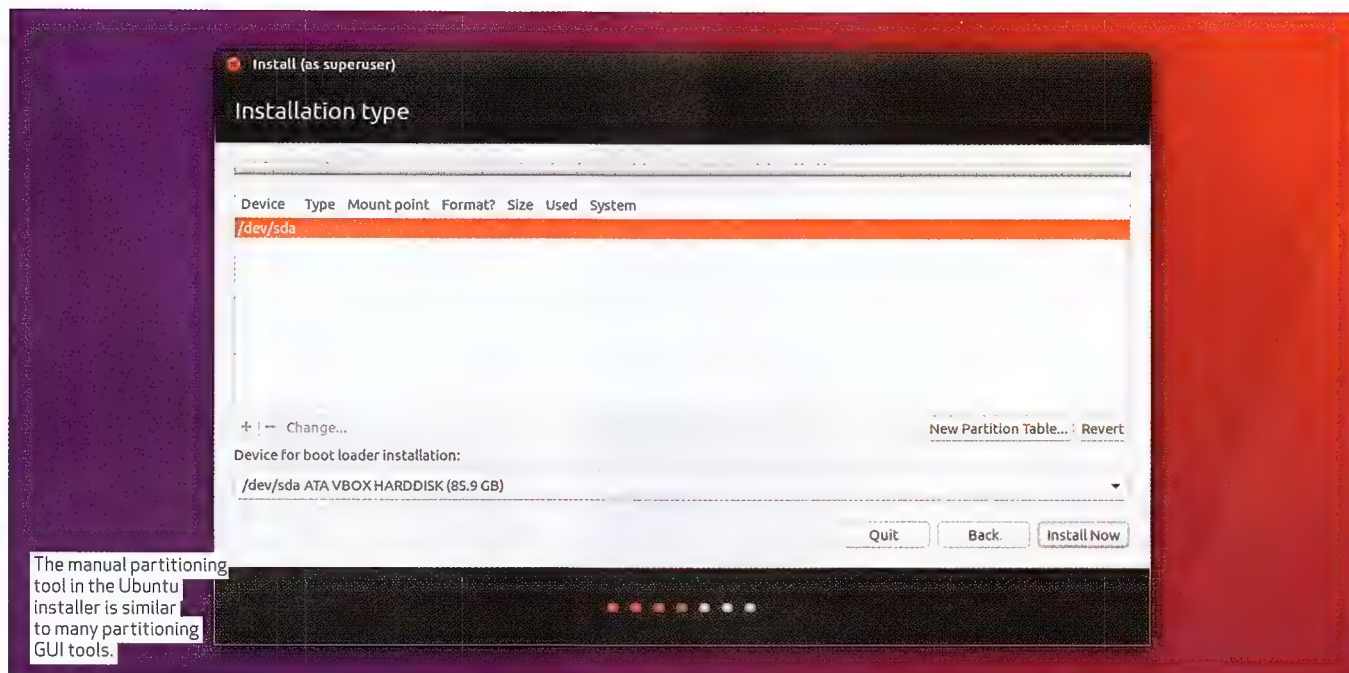
```
> bootrec /fixmbr
```

Reboot and boot into Windows. Then move onto using the Ubuntu live CD. Boot from the CD and choose Boot-Repair. If it isn't installed, then you can try to install through a few simple terminal commands that you can type one by one:

```
# sudo add-apt-repository
ppa:yannubuntu/boot-repair
# sudo apt-get update
# sudo apt-get install boot-repair
```

Next, simply boot-repair and click the 'Recommended Repair' option.

Last, to remove the Ubuntu partitions, you'll need to head back into Windows, reboot and boot into Windows and open Disk Management by searching for it in the Windows menu. In disk management, right click the Ubuntu partitions and select 'Delete'. This is the point of no return so make sure you're good to go before you click that button. If you plan to just keep using Windows, then right click



the Windows partition and select 'Extend Volume'. This will increase the size of the Windows partition to fill up the free space. That should be all that is needed to restore the machine to using only one operating system.

Now that you know how to add and remove operating systems to and from a computer in a dual-boot situation, you are ready to tackle your own project with other distros and combinations. As a final note, there's also the possibility of adding more OSes to your boot sequence, creating triple-boot or multi-boot systems. Adding systems essentially follows the same basic steps of partitioning and adding as space allows to the hard drive. With more operating systems comes more versatility and using the bootloader to your advantage can allow you to truly make your computer your own and design an environment suited to your needs.

Re-ordering the Boot Manager

You'll notice that when you boot from a shutdown state, there's a certain order to things. The Windows operating system or the Linux one will be given priority and unless you press keys during startup, you'll end up automatically booting into one system or the other, whether you wanted to or not.

This is a common issue that's easily remedied. You can use the EFI Boot Manager tool that you can access from an Ubuntu Live CD. Once in the Live CD environment, open a terminal and install EFI Boot Manager with the following:

```
# sudo apt-get install efibootmgr
```

Next, use the following command to find out the current boot order situation:

```
# sudo efibootmgr .
```

You'll get an output that looks something like this, with the

boot order listed:

```
BootOrder: 0004,0001,0002,0005
Boot0001 Windows Boot Manager
Boot0002 Network
Boot0004 ubuntu
Boot0005 Hard Drive
Boot0006 CD/DVD/CD-RW Drive
```

To change the boot order, we will have to use the numerical codes which correspond to the boot device that we want first. For example, in this case, we want the system to try to boot from CD first, followed by Ubuntu and Windows. So we will use the following command to change the boot sequence:

```
# sudo efibootmgr -o 0006, 0004, 0001
That's it — you're now ready to go. ■
```




Build a robust testbench PC

Zak Storey introduces one of the machines we'll be using to test hardware over the coming year.

THE CONCEPT

Every issue, we dissect a plethora of hardware for your reading pleasure. It could be anything from headsets to processors, graphics cards to motherboards. And ideally, much of that hardware needs to be put through its paces on a quantifiable, standardised test bench. In short, as much as is feasible, we try to keep the systems we use for each product as close to identical as possible. This helps ensure that our results across multiple motherboards, GPUs, CPUs or memory kits aren't affected by any spurious system irregularities or instabilities.

Getting these things set up correctly imperative for providing solid, reliable

results, and something many a hardware reviewer will pride themselves upon, ourselves included.

But when it comes to building a solid test bench, there's a whole variety of factors to consider. First of which is the choice of chassis. Generally speaking, you have two routes. You can go with a fully enclosed case or you can opt for an open-air test bench. The latter, however, tends to be less conducive to accurate cooling benchmarks (after all, it doesn't replicate a typical, everyday fully enclosed system).

But case choice, accessible airflow and ambient temperatures vary so widely among our audience, that it's often less about what specific

temperature the coolers and fans can maintain, but more what variances in temperature and noise are noted between two different cooler designs, something we then balance with strict ambient temperature controls and thermal load testing.

On top of that, opting for an open-air case makes swapping out hardware far easier and quicker. Which means that, when it comes to supertests and error testing, it can be achieved far faster than when we're using a closed chassis.

As you've probably guessed, we're about to show you one of our main test benches for 2017 – which hardware we've chosen, which niggles we've found and how we've overcome them.

HARDWARE VARIATIONS

So where did we start with this new test bench? With the fixed components. We knew we wanted a new test bed, and Raijintek's Paeon Aluminium ATX Bench Table caught our eye. Squeaky clean and providing far better mounting options than our previous one, it was the obvious choice. Finding it in Australia wasn't an option, however; we had to source ours from the UK. Next up was the cooler. We stuck with our trusty NZXT Kraken X61, coupled with two Noctua NF-A14 iPPC fans. It's not the fanciest all-in-one water cooler, but its vast surface area and fantastically easy mounting system make it a snap to set up.

We also decided to play around with our storage this year. Moving the OS from the 500GB 850 Evo to the 250GB 960 Evo M.2 and using the Crucial MX300 1TB as our games and file storage drive, as opposed to the 2TB Samsung 850 Pro, made sense. Finally, Be Quiet's Dark Power Pro 11 1,200W PSU would be providing the juice, as it has done for the last 18 months.

As we test a variety of products, the test bench has to rotate to compensate. A new X99 board? Then it's four sticks of DDR4 Dominators, alongside an Intel Core i7-6950X. AM4+ and Ryzen? A new motherboard and high-end processor should do the trick. GPUs launched? We'll stick with the Z270 setup, and swap the GTX 1080 out instead. A test bench constantly changes, so while it has to adhere to solid principles on what hardware is included, it must also be flexible, depending on the gear being tested.

PARTS LIST

PART		STREET PRICE
CASE	RAIJINTEK PAEAN ALU-MINUM TEST BENCH	\$255
MOTHERBOARD	ASUS MAXIMUS IX HERO	\$429
CPU	INTEL CORE I7-7700K	\$499
MEMORY	16GB (2X 8GB) CORSAIR DOMINATOR PLATINUM DDR4 2,400MT/S	\$219
GPU	NVIDIA GEFORCE GTX 1080 FOUNDER'S EDITION	\$1,099
PSU	BE QUIET! DARK POWER PRO 11,200W	\$369
STORAGE 1	250GB SAMSUNG 960 EVO M.2	\$189
STORAGE 2	500GB SAMSUNG 850 EVO 2.5-INCH SSD	\$228
STORAGE 3	1TB CRUCIAL MX300 2.5-INCH SSD	\$449
COOLING	NZXT KRAKEN X61 + 2X NOCTUA NF-A14 IPPC	\$277
TOTAL		\$4,013

We try to keep the systems we use for each product as close to identical as possible. This helps ensure that our results across multiple motherboards, GPUs, CPUs or memory kits aren't affected by any spurious system irregularities or instabilities.



1 FRONT I/O PROBLEMS

Test beds take the most abuse of any system we put together here in the APC office. They have all sorts of hardware installed and pulled out again several times in one day, often three or four times a week. And because of that, they have to be built from the right stuff. Unfortunately, just one week in, we accidentally broke the front I/O on Raijintek's Paeon, which meant we had to repair it using good old packing tape, just to keep it in one piece. It doesn't look particularly glamorous, but most test benches we've used prior to this lacked a front I/O altogether, with us either booting via an onboard switch or shorting the two power pins on the motherboard itself most of the time.



2 GHETTO RADIATOR MOUNTING

Next up were cooling issues. By design, the Paeon is meant to be a fully liquid-cooled test bench solution. The theory is, you place a combi res in here, with a pump to the right of the motherboard, then a triple thick radiator to the right of that. Although that's certainly a possibility, we're not keen on deviating from the more common AIO yet, because it's more relevant to consumers, at least in our eyes. That said, mounting it the traditional way means our tubes aren't long enough — so, to circumvent this, we attached the radiator sideways on the radiator panel, by carefully threading cable ties through the corners of each fan, using the radiator screw as our anchor point. This keeps it secure, and means we can still reach the processor with ease.



3 THE NEW STANDARD

We've been a big advocate of M.2 PCIe drives for quite some time now. In fact, if you're building a modern system, using any of the new chipsets from either Intel or AMD, your best bet is to go for an M.2 PCIe SSD for your OS. The sequential read and write speeds alone are mind-bending. It was a tricky decision to make, though, because they're still not widespread just yet, and on top of that, booting from them requires Windows 10, and you also need that chipset support or an add-on card to make it a reality. However, the 960 Evo won us over, purely due to its exceptional value for money performance-wise.



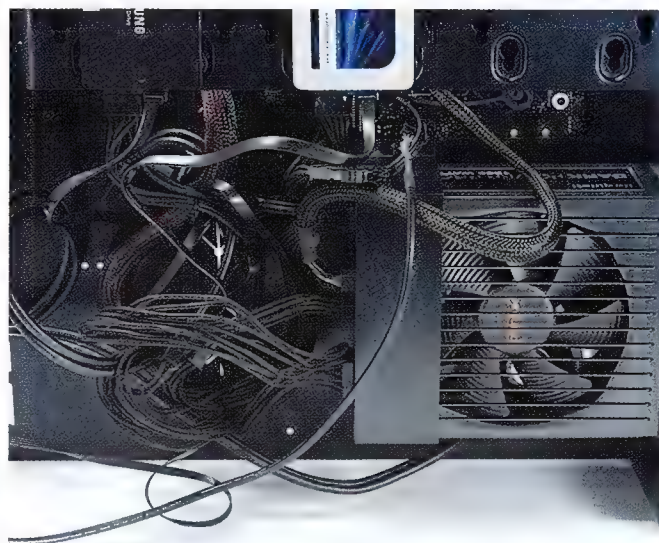
4 MULTI GPUS

One of the neat features of the Paean is the PCIe bracket. Now, we know what you're thinking — why on earth is this such a big feature? The thing is, the vast majority of test bench manufacturers seem to fail every single time they attempt this, with many using either pins or disproportionate supports for the GPUs, leading to frantic and troublesome mounting solutions. Fortunately, with its tempered glass, the Paean is just as much a showcase as a test bench, so the mounting solution here is exceptionally solid, and enables us to test up to four-way CrossFire or two-way SLI if we so desire.



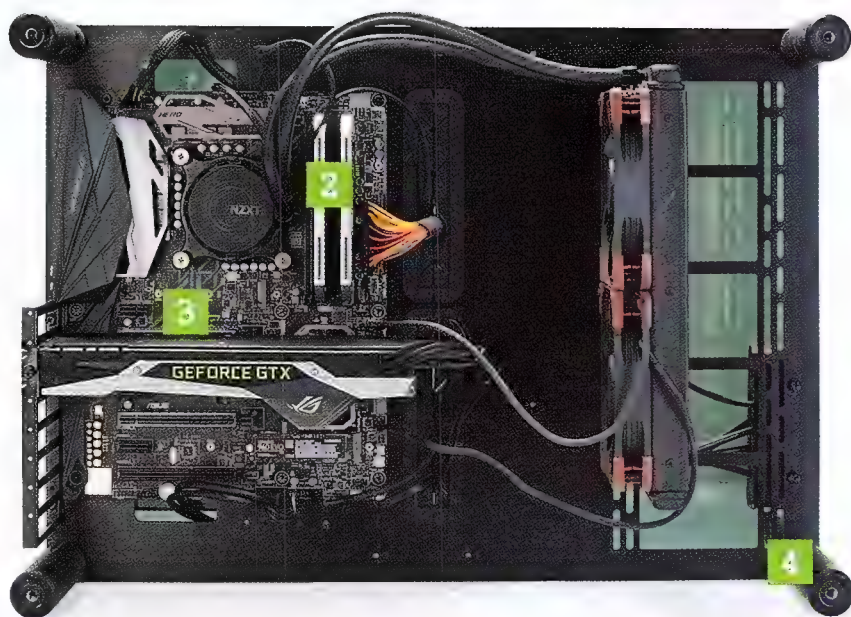
5 STORAGE CHANGES

Not only did we decide to swap out the operating system to an M.2 PCIe SSD, but we also transferred all of our benchmarking files across from the Samsung 850 Pro 2TB on to this Crucial MX300. Now, let's be honest, it's not going to blow anyone away when it comes to performance, but as a workhorse drive for mass storage, it's exactly what we need. The Sammy 850 was being underused acting just as our games and files storage drive, and it has been put to better purpose elsewhere because of this change. On top of that, this neat mounting mechanism means we can pull the Crucial MX300 out whenever we need it, to hook it up to any system we choose with a USB 3.0 to SATA cable with relative ease.



6 CABLE MANAGEMENT? WHAT'S THAT?

OK, so this isn't the tidiest build we've ever done (actually, we've always been pretty lax when it comes to cable management), but this is entirely for good reason. Because we swap out hardware at an alarming rate, we need slack cables to cater for the constant shuffling around. The last thing we want is to struggle to unplug a CPU or PCI power on the fly. You'll also notice we're still running our trusty 1,200W Be Quiet! Dark Power Pro 11 PSU. It's super, uh, quiet, and has enough headroom to plug in multiple GPUs without much issue, making it one sweet piece of kit. We've also thrown in a few CableMod sleeved cables for good measure — although, due to the fact that this \$370 PSU is semi-modular, we refused to plug in the extension lead for the 24-pin ATX.



- 1 Our NZXT Kraken X61 is looking a little withered at the moment, but we'll probably swap it out for a custom closed loop, featuring a triple 120mm radiator, later in the year.
- 2 Corsair's Dominator Platinums replace our trusty Crucial Ballistix Elites this time around, primarily because they're part of an 8x 8GB kit that we can use in our X99 platforms, too.
- 3 We had to make a special request to get the Maximus IX Hero in from ASUS to be our dedicated test bench for 2017. It's a true performer, and looks pretty classy to boot.
- 4 We'll probably run this test bench with the glass side panel off. It makes it easier to access the insides, and the risk of getting fingers caught in fans is the least of our concerns.

"The biggest challenge was assembling the Paeon itself. The case comes flatpacked, so you have to attach the eight legs, then add all the other major components."

Old versus new

Out with the old and in with the new, eh? It was a sad occasion when we benchmarked our aging Z170 test bed to see how this new one stacked up. It's performed admirably, and to be fair, a large chunk of it is actually staying with us. You may have noticed the Samsung 850 Evo 500GB is still plugged in the back, for instance, sitting next to the Crucial MX300 – but, alas, it won't be making the journey with us, as it's purely there to transfer over any files we may need, and is soon to be removed.

So how was it to piece together? Well, open-air test benches are some of the easiest builds we ever create. The biggest challenge was assembling the Paeon itself. The case comes flatpacked, so you have to attach the eight legs, then add all the other major components. The instructions could use some work, as we struggled to find the right screws for mounting the front I/O panel (probably what caused us to break it), and installing the PSU was a pain as well.

The biggest decisions were with regard to finalising test benches for this year. We've all but wrapped up our Broadwell-E processor testing, so there's no need to pick a single X99 motherboard. As such, that specific test rig will remain pretty much cemented in place, with motherboards swapping in and out until we start seeing Skylake-X and its Kaby-X twin.

For X99 motherboards, we plan to use the Intel Core i7-6950X, with 32GB (4 x 8GB) of Dominator Platinums. SSD testing will mostly be handled by this new Kaby Lake base test bed, aka the Z270, with the same going for any new GPUs and coolers that come out, until a new consumer chipset arrives as well. And of course, Z270 motherboard testing will be handled by the Core i7-7700K, the GTX 1080 and the storage solution we have on board. The real wild card is Ryzen. We're not sure what's going to happen with AMD's new champion and its chipset. However, it's unlikely we'll swap out from Z270, at least not until 2018. Same goes for GPUs, with AMD's Vega looking likely to launch in June of this year.

The big question is: Do we get some proper water cooling on the go? We've

certainly got the hardware to do it, but there are pros and cons. The positives? It would allow us to potentially push overlocks higher, as we wouldn't be so limited by thermal issues. And we can ensure the tubing is the correct length and the entire cooling table is controlled by us directly. Plus, it looks awesome. The negatives? Well, there's the fact that if we're reporting temperatures on CPUs (which we do, occasionally, for a new processor launch), it would mean swapping out the loop for an AIO, because the number of people using fully water-cooled loops like that would be very few. And once Ryzen does launch, the AMD prodigies won't be using the same socket design as Intel, so we'd need to drain the loop and attach a new waterblock. Decisions, decisions... ■

BENCHMARK RESULTS

	OLD TEST BENCH PC	THIS SYSTEM
CINEBENCH R15 MULTI-THREAD	923	963 (4%)
CINEBENCH R15 SINGLE-THREAD	179	193 (8%)
TECHARP'S X264 HD 5.0.1 (FPS)	20.44	21.48 (5%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	549	3147 (473%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	522	1572 (201%)
RISE OF THE TOMB RAIDER (FPS)	67	67 (0%)
FAR CRY PRIMAL (FPS)	105	105 (0%)
THE DIVISION (FPS)	101	102 (1%)

Our old test bench used a Core i7-6700K, 16GB of Crucial Ballistix Elite DDR4 at 2666, an Nvidia GTX 1080 and a 500GB Samsung 850 Evo. All games tested at 1080p on max settings, with HD texture packages installed.



Protect your network with a Pi-based firewall

Turn your Pi into an ultra-secure access point complete with firewall to protect your computer from the dark side of the internet.

You may remember that, in December 2016, the media reported that the infamous Mirai worm had infected a substantial number of routers used by customers of UK ISP TalkTalk, stealing their Wi-Fi passwords. The worm exploited the default admin passwords that are hardwired into a number of machines, and although the focus was on enslaving devices to take part in DoS (Denial of Service) attacks, the implications are staggering. Even those handful of users who take the trouble to change their router's default passwords seldom bother to use firewalls.

In plain English, this means your router's settings, and theoretically devices on your home wireless network, could be laid bare by attackers. Fortunately the Raspberry Pi comes to the rescue once again. We'll show you how.

This project can be roughly divided into two parts. The first is to set up your Pi as a wireless AP (access point). In other words, the Pi itself will create a wireless network for you to connect to. The Pi can then be connected to your router, so that anyone connected to its wireless network can continue to access the internet.

The second part of this project involves installing an easy-to-use firewall on your Pi which will block any open ports that attackers can exploit. You can also configure the firewall to allow access to legitimate programs, as well as block any websites you think are unsafe. Provided you have the correct equipment, you can have your own secure AP with firewall up and running in under 20 minutes.

THE BARE NECESSITIES

The wireless device you use must be compatible with hostapd (more about this shortly). This project is technically

compatible with all models of Pi, although the Pi needs to be both wireless-enabled and have an Ethernet port to connect to your router. The Raspberry Pi 3 lends itself very well to this. Setup if at all possible should be done using a keyboard and monitor rather than SSH as once the Pi has created its own AP, you won't be able to connect to it wirelessly. You can, however, connect to it through your router's wireless network if you know the IP address.

If you prefer the compact Pi Zero, make sure you have both a USB OTG Host cable or a USB-to-MicroUSB OTG shim (available from all Pi accessory suppliers). You'll also need an RJ45-to-USB converter to attach to the USB port. You'll then be able to connect the Pi Zero to your router.

In addition to the Pi itself, you'll need a secondary device to check that the wireless AP is functioning correctly, as well as a network cable to link the Pi

to the router. Most modern routers have at least one USB port, so you should be able to power the Pi from there.

For security reasons and to save on resources, it's best to have a dedicated Pi for your home firewall, rather than one that you might use for other purposes in addition. If at all possible, plug your Pi into a monitor and work from Terminal directly when going through this project rather than connect via SSH. This reduces the chance that your connection will drop at a vital stage in the proceedings.

As always, it's best to start with a clean install of the latest version of Raspbian on the Pi. Once the install is complete, open Terminal and run the following commands to be certain your system is fully up to date:

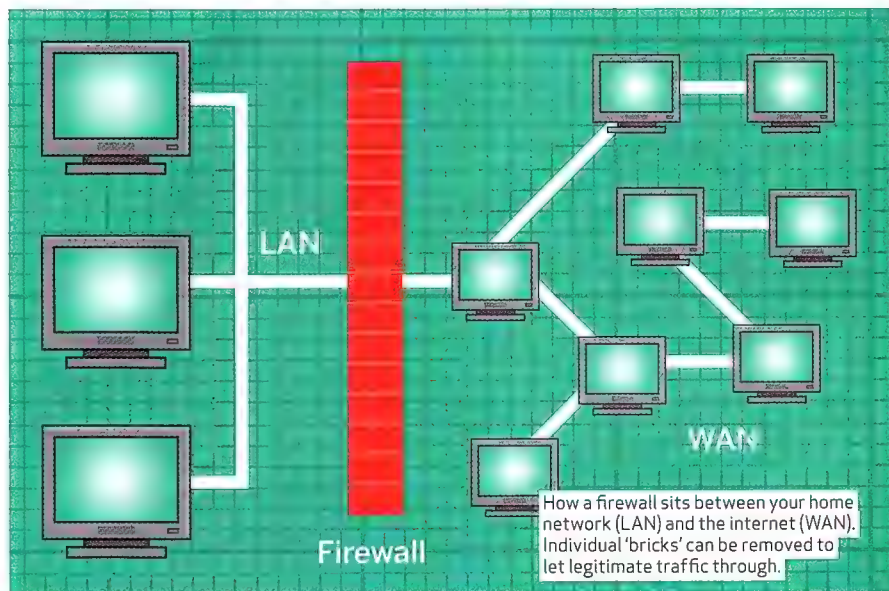
```
sudo apt-get update
sudo apt-get upgrade
```

If you do not have access to a monitor, you can connect to the Pi wirelessly through your router's Wi-Fi network via SSH. Connect your Pi to the router via Ethernet cable first. If you have a mobile device, the handy app Fing can be used to easily identify the IP address of all devices on your local network. Fing is available to download free of charge from both the iOS App Store and Google Play.

Once you're satisfied that the AP is working as you'd like, make sure to disable the wireless function on your router to prevent people from connecting to it instead of the Pi firewall.

TALKING POINTS

The access point is set up and managed by the handy program hostapd. Step 3 of our guide on page 97 covers creating



a configuration file wherein you'll specify the settings for the Pi's new wireless network such as name, password and encryption type used. You can return to this hostapd.conf file at any time to change your settings if you wish.

While every wireless card can connect you to a Wi-Fi network, not all Wi-Fi cards can generate their own wireless networks. Fortunately, the Wi-Fi module built into the Raspberry Pi 3 does support this feature, which is a good reason to consider using one for your firewall.

We'll also install the devilishly clever program dnsmasq to handle the network infrastructure. It also draws its settings from a small configuration file, which you will set up in Step 4. The suggested settings have dnsmasq use Google for its DNS server (8.8.8.8) but you can change this to another DNS

provider if you wish, such as OpenDNS (208.67.222.222). For best performance, you may want to list more than one DNS server. To do this, simply add a new line for this in the dnsmasq.conf file, for example

```
server=208.67.222.222
server=208.67.222.220
```

UNCOMPLICATED FIREWALL

Ufw (Uncomplicated Firewall) comes bundled with a number of Linux distros and, true to its name, is very simple to use. It is by no means the only firewall program out there – in fact, there are entire distributions of Linux such as IPFire in the wild which are specifically designed to act as a gateway between your computer and the internet, complete with colourful windows. Why then use a rather mundane command line application?

Domain denial

Its full name, Uncomplicated Firewall, might sound modest, but Ufw is a powerful firewall and can be used to block access to certain websites. Although technically you can also do this with dnsmasq, this would be a form of 'DNS hijacking', which is a rather dastardly procedure usually carried out by scammers.

The advantage of using Ufw is that it blocks domains by IP address. This means you have to write down only one rule per address rather than remember the various domains and subdomains used by sites. Imagine trying to block every variant of Facebook.com, for instance.

It stands to reason, then, that in order to block websites by IP address, you'll need that information. Open Terminal on your Pi or connect via SSH and use the `host` command to view an objectionable page's IP address — for instance:

```
host strawberryfunk.com
```

This will output the IP address of the site in question. Next, use `ufw deny` to block this domain — for example:

```
sudo ufw deny
out from any to
205.178.189.29
```

You can check that the domain has successfully been blocked by using `ping` — for example:

```
ping -c 1
strawberryfunk.
com
```

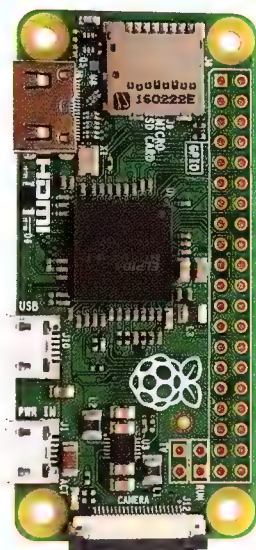
If you have set up Ufw correctly, ping will report that the domain is unreachable.

Ufw can also block outgoing connections to certain ports. For instance, if you want to reduce the chance of your Pi being used to send spam messages, you can disable Port 25 with the following:

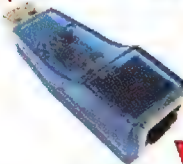
```
sudo ufw deny out 25
```

```
fish /home/pi
pi@raspberrypi ~$ host strawberryfunk.com
strawberryfunk.com has address 205.178.189.29
strawberryfunk.com mail is handled by 10 p.webcom.cdnail.com
pi@raspberrypi ~$ sudo ufw deny out from any to 205.178.189.29
Rule added.
pi@raspberrypi ~$ ping -c 1 strawberryfunk.com
ping: strawberryfunk.com (205.178.189.29): 56(84) bytes of data
--- strawberryfunk.com ping statistics ---
1 packets transmitted, 0 received, 100% packet loss, time 0ms
pi@raspberrypi ~$
```

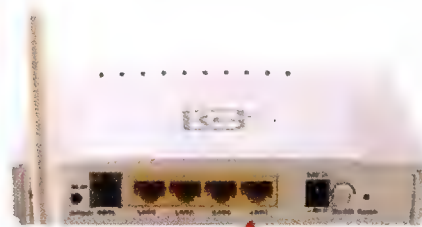
Use ping to check that a domain has been successfully blocked. Some websites have more than one IP address, so block each of these in turn.



2



3



4

Serving suggestion for Pi Zero internet connection. The OTG cable (2) allows connection of regular USB devices. The RJ45 converter (3) allows connection via Ethernet.

Aside from the fact that Ufw has withstood the test of time, it's very easy to install and set up. Once enabled, it will launch automatically. By default it will block all incoming connections and allow all outward ones. This can be a nuisance if you and other users on your network want to use certain applications like BitTorrent or Skype, but fortunately, configuring exceptions to these rules is easy. Ufw also has a graphical companion for those who are still not entirely comfortable with the command line. See *Configuring your Firewall*, below, for more information.

Ufw also has the ability to block connections to specific IP addresses

or ranges, so you can prevent network users from visiting certain websites — see *Domain Denial* back over the page).

Although Ufw can be used to block individual websites, any web pages that do load will display banner advertisements and pop-ups. By far the easiest way to deal with these is for you and other users on your network to install browser extensions such as Ublock Origin and Ghostery to prevent both adverts and tracking cookies. Mobile users can also benefit from the official Adblock Browser.

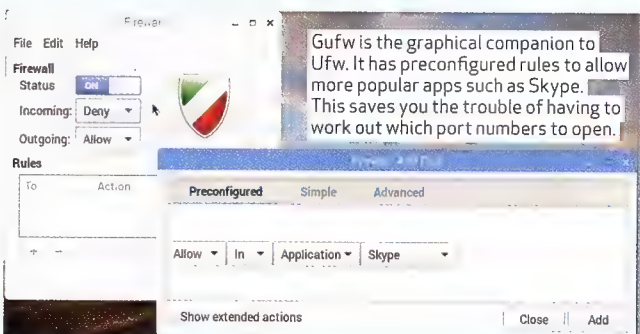
If this isn't feasible, you can remove the Pi's default DHCP (Dynamic Host Configuration Protocol) server and configure dnsmasq in its place to

automatically redirect known ad servers to an internal IP address. By default, this will create ugly blank spaces in the middle of your web pages, but you can solve this by also installing the handy app pixelserv. Pixelserv's sole purpose in life is to support ad-blocking via serving a transparent 1x1 pixel GIF image in place of adverts. This makes your ad-blocking a much tidier experience.

If you're interested in adding an ad-blocking feature to the Pi, a tutorial is available on the Adafruit website: learn.adafruit.com/raspberry-pi-as-an-ad-blocking-access-point

Configuring your firewall

Once enabled, Ufw will automatically launch on startup, blocking all incoming connections and allowing all outgoing ones. This might not be the ideal setup for you, particularly if you like to connect to your Pi via SSH or VNC. To configure Ufw, use Terminal on your Pi. Ufw recognises most services like SSH, so in most cases, you can enable access using `ufw allow` — for instance:



```
sudo ufw allow ssh
```

To see a full list of services you can enable in this way, simply run the following command:

```
nano /etc/services
```

If your service isn't listed, you can simply open the port it uses. For instance, RealVNC, which can be used to connect remotely to the Pi's desktop, runs on Port 5800. To have Ufw open it, run:

```
sudo ufw allow 5800
```

To allow connections only from a specific IP address, use `from` — for instance:

```
sudo ufw allow from 192.168.1.12
```

For a complete readout of the Firewall settings in Ubuntu, use the following:

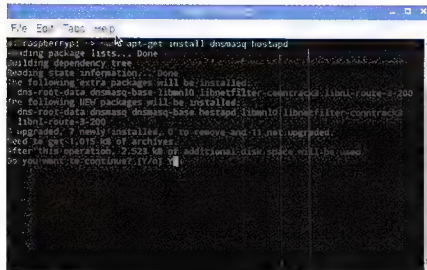
```
sudo ufw status verbose
```

To make life even easier for you, Ufw has a graphical companion, Gufw. To open it, run:

```
sudo gufw
```

There's a handy rocker switch as well as a list of open and blocked ports. Click the '+' button to add additional rules. Click 'Show extended actions' to see preconfigured settings for certain popular applications such as Skype.

Create your firewall with Ufw



1 INSTALL PREREQUISITES

Plug your Pi into the Ethernet port on your router, then connect via SSH or ideally open Terminal on the Pi. Install the necessary programs by running:

```
sudo apt-get install dnsmasq hostapd
```

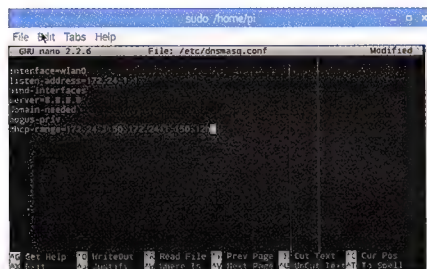
Next, run the following to open the configuration file:

```
sudo nano /etc/dhcpd.conf
```

Add these lines to the very bottom of the file:

```
interface wlan0
static ip_
address=172.24.1.1/24
```

Press Ctrl-X, Y, then Return to save and exit.



4 CONFIGURE DNSMASQ

Move the old dnsmasq configuration file with:

```
sudo mv /etc/dnsmasq.conf /
etc/dnsmasq.conf.orig
```

Then create a new one by running:

```
sudo nano /etc/dnsmasq.conf
```

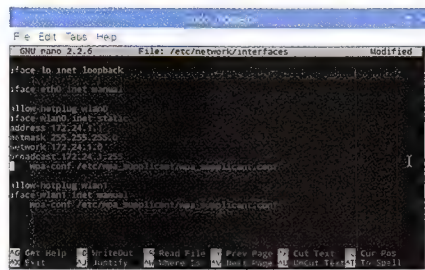
Paste in the following text:

```
interface=wlan0
listen-address=172.24.1.1
bind-interfaces things
elsewhere
server=8.8.8.8
domain-needed
bogus-priv
dhcp-
range=172.24.1.50,172.24.1.150,
12h
```

Save and exit. Now run:

```
sudo nano /etc/sysctl.conf
```

Find the line starting 'net.ipv4.ip_ forward=1' and remove the '#' at the start. Save, exit and reboot the Pi.



2 SET STATIC IP

Open your network interfaces configuration with:

```
sudo nano /etc/network/
interfaces
```

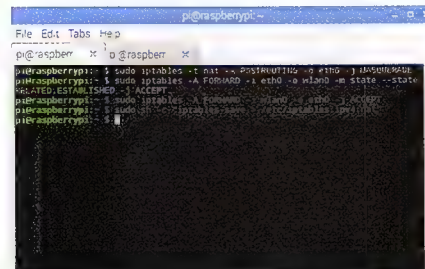
Find the line 'iface wlan0 inet static' and change it to:

```
iface wlan0 inet manual
```

Press Return to start a new line, then paste the following:

```
address 172.24.1.1
netmask 255.255.255.0
network 172.24.1.0
broadcast 172.24.1.255
```

Place a '#' at the start of the line beginning 'wpa-conf'. Save and exit in the same way as before.



5 SET UP IPV4 FORWARDING

Open Terminal on your Pi and run:

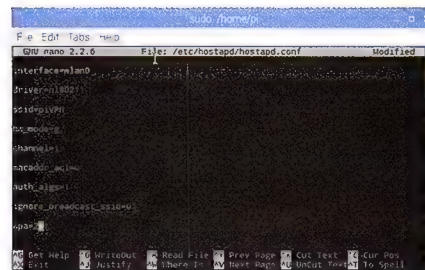
```
sudo iptables -t nat -A
POSTROUTING -o eth0 -j
MASQUERADE
sudo iptables -A FORWARD -i
eth0 -o wlan0 -m state --state
RELATED,ESTABLISHED -j ACCEPT
sudo iptables -A FORWARD -i
wlan0 -o eth0 -j ACCEPT
sudo sh -c "iptables-save > /
etc/iptables.ipv4.nat"
```

Next, run:

```
sudo nano /etc/rc.local
```

Paste the following two lines just above the line reading 'exit 0':

```
iptables-restore < /etc/
iptables.ipv4.nat
/usr/sbin/hostapd /etc/
hostapd/hostapd.conf
```



3 SET UP ACCESS POINT

Open the hostapd.conf file by running:

```
sudo nano /etc/hostapd/
hostapd.conf
```

Paste the following:

```
interface=wlan0
driver=nl80211
ssid=piVPN
hw_mode=g
channel=1
macaddr_acl=0
auth_algs=1
ignore_broadcast_ssid=0
wpa=2
wpa_key_mgmt=WPA-PSK
wpa_passphrase=raspberry231
wpa_pairwise=TKIP
rsn_pairwise=CCMP
```

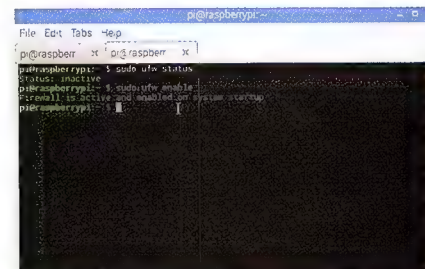
Change the SSID, passphrase and network encryption as you see fit. Next run:

```
sudo nano /etc/default/
hostapd
```

Find the line starting '#DAEMON_CONF="'.

Remove the '#' at the start of the line and change it to:

```
DAEMON_CONF="/etc/hostapd/
hostapd.conf"
```



6 SET UP FIREWALL

Run the following commands, one after the other:

```
sudo update-rc.d hostapd
enable
sudo update-rc.d dnsmasq
enable
```

Reboot the Pi, and reopen Terminal.

To install and then enable the firewall, run the following:

```
sudo apt-get install ufw gufw
sudo ufw enable
```

You may wish to configure the firewall at this stage — see 'Configuring your firewall' on the opposite page.



Connect to Hidden Wi-Fi Network



Hidden Wi-Fi network

Enter the name and security details of the hidden Wi-Fi network you wish to connect to.

Connection:

Network name:

Wi-Fi security:

Password:

☒ Show password

Connecting to a hidden network makes life only slightly more difficult for other network users but much harder for hackers.

BUILDING BRIDGES

This project focuses on bridging the connection between your Pi's wireless interface and the Ethernet interface. This allows your Access Point to remain connected to the internet. If you need to double-check the names of your interfaces, you can run the command `ifconfig` at any time. By default, the names of these interfaces should be "wlan0" and "eth0", respectively.

If you're unable to plug the Pi into a router, theoretically, you could add another wireless interface such as the official Raspberry Pi Wi-Fi module and use it to access your router's wireless network. However, this is less secure and will reduce your connection speed. If your router is somewhere hard to reach (or actually out of range), consider using a "homeplug" style device which uses the power lines in your home or office for network connections.

Do not despair if the Access Point or the firewall do not work the first time you go through the steps. Fortunately, the Pi's network settings are very flexible, so you can usually go back over the steps again without having to reinstall Raspbian.

If you're using a Wi-Fi driver besides that built into the Pi 3 or the official Raspberry Pi Wi-Fi adapter, then you may have to change the 'driver=' value in `hostapd.conf`. For information visit linuxwireless.org/en/users/Documentation/hostapd.

You can disable the Ufw firewall permanently and delete all rules with:

```
sudo ufw reset
```

If required, you can also restore the settings you previously backed up with `dnsmasq` by reversing the original command:

```
sudo mv /etc/dnsmasq.conf.orig /etc/dnsmasq.conf
```

If you choose to block specific ports or services (see Domain Denial on page 95), bear in mind that IT-literate users on your network may bypass this via a VPN. You can, of course, use Ufw to block the ports commonly used by VPNs, such as 1154, or block all outgoing traffic and then enable it for specific applications and services. Some applications will randomise the ports used, making it difficult to lock down specific protocols like BitTorrent. You might consider disabling UDP (User Datagram Protocol) if you want to prevent streaming of most music and video sites.

If you choose to use a browser extension or pixelserv to block ads, certain sites may display incorrectly or fail to load altogether. Adblocking extensions can usually be disabled temporarily by clicking on their icon in your browser's menu bar.

For security reasons, it would be wise to use a dedicated Pi exclusively as an Access Point and avoid placing any personal data on it. For extra safety, make sure to use a long, robust password – the one in the tutorial is only by way of example.

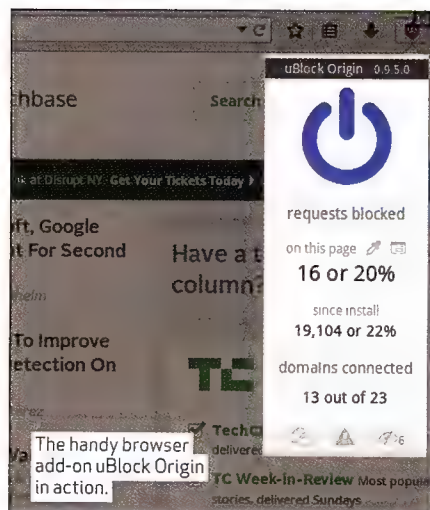
For the uber-cautious, consider creating a hidden Wi-Fi network for the Pi. Edit the `hostapd` configuration by opening a Terminal and typing:

```
/etc/hostapd/hostapd.conf
Change "ignore_broadcast_ssid=0"
to "ignore_broadcast_ssid=1".
```

From now on, all devices will have to enter the name of the network as well as the password in order to connect. Consider setting a new name when editing the file to be extra secure.

If you have devices using a cabled connection like a home server, you can continue connecting these directly to your router for internet access but bear in mind that they won't be visible on the Pi's wireless network. This works both ways, however – the Pi will not interfere with their operations at all.

Finally, bear in mind that your router may also use a firewall. If you're comfortable with configuring your router, you can choose to open and close ports to match Ufw's settings. Alternatively, you can disable the router's firewall altogether and let the Pi manage everything. ■



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How to unroot your Android phone or tablet

Those custom ROMs look colourful and shiny, but things don't always go to plan. Darren Yates investigates the process to revert your phone back to a stock operating system.

When you buy a phone and it's weighed down with bloatware and locked to within an inch of its life, the lure of custom ROMs can be pretty hard to resist. That's not necessarily a bad thing – there are some excellent community ROMs available. But that doesn't mean they will suit everyone.

Some ROMs are early 'alpha' stage and not much more than 'here's what we hope to do' previews (and usually come with warnings to that effect). Others are generally more complete but may still have bugs preventing that one feature you need above all others from working. Throw in the recent upheaval surrounding CyanogenMod (tinyurl.com/j4rp9jx) and it's not surprising there's a tide drifting back towards official or 'stock' ROMs. So rather than flashing a custom ROM, this month, we're looking at how – or if – you can go back to a stock ROM.

FINDING STOCK ROMS

How successful you'll be depends on being able to find a stock ROM for your device. The chances are that, in your original rush to install a custom ROM, you didn't take a backup of your original. This can be good, but more probably bad, depending on your phone.

Some phone brands, such as the Samsung Galaxy series, are incredibly well supported, thanks to sites like Sammobile (tinyurl.com/hnu5lqt) that keep a store of every stock ROM update released for every Samsung device.

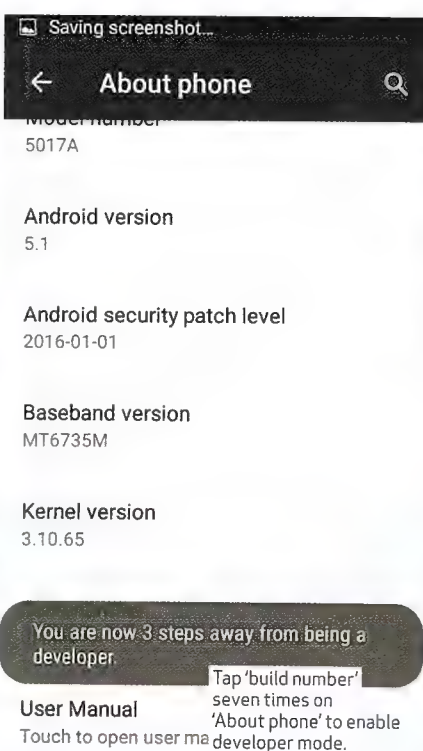
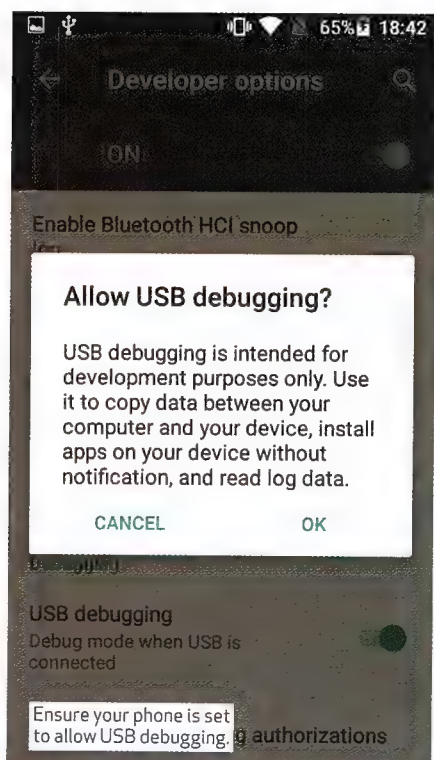
Some brands don't keep a public cache of stock ROMs available, but instead, provide a special 'ROM Update Utility' (RUU) to update the phone automatically. For example, Alcatel provides a Windows app called 'Mobile Upgrade S' that automatically downloads the correct stock ROM for a range of Alcatel phones. Downloads using these app-based restore systems can be in excess of

WARNING

While the method featured in this story has been tested, it is presented 'as is' and without warranty. It is not recommended for beginners or newbies. We cannot guarantee it will work for all devices and you must do your own further research to ensure success.

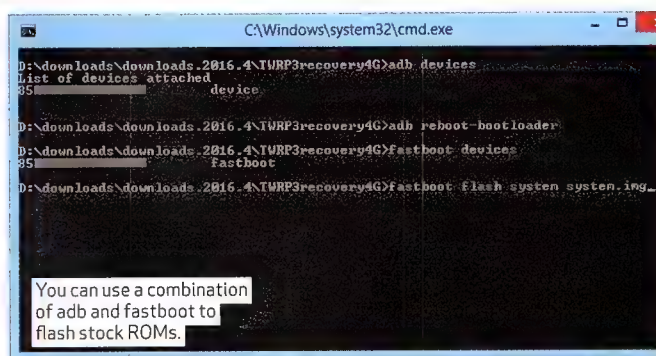


Google's Pixel phones reportedly can use fastboot ROM flashing.



1GB, but what's impressive about this app, in particular, is its ability to recover phones that have been 'soft-bricked' or locked in a continuous boot-loop (yes, we know from experience). For most other phones, however, you'll have to find a stock ROM yourself.

Now the one thing we cannot stress enough at this point is the importance of finding the right ROM. You can't just wing it and hope that a ROM that seems vaguely right will work. If the ROM is not meant for your exact, specific



device model, don't install it. If you do, the chances of bricking it are high.

DIFFERENT ROM TYPES

A complete Android smartphone firmware setup is actually made up of multiple ROMs – including boot, recovery, radio/modem and system.

The 'boot' ROM contains the kernel and RAMdisk for normal booting of the device – the kernel is the base-level software-hardware translator engine, while the RAMdisk provides the associated file store. The 'recovery' ROM is another kernel/RAMdisk pairing but more like 'system restore' in Windows – it allows you to wipe the various caches, perform a factory reset, backup and restore, even flash new apps and new versions of Android. Custom recovery options like TeamWin Recovery Project (TWRP) and ClockworkMod (CWM) add the ability to flash custom versions of Android.

Deciding which of these two ROMs boots up is the job of the 'bootloader', the initial code that fires when the device is first switched on. Increasingly, phone makers are choosing to lock the bootloader from loading anything other than official ROM code (while the Android community works feverishly to unlock it again).

The 'radio/modem' ROM is software specifically focused on the phone network transceiver (TX/RX) function of your device and, finally, the 'system' ROM is the Android operating system that runs your apps and games.

Each of these ROMs is essentially modular in form – you can install the Android OS system ROM separately to the recovery ROM, for example, although you'll often find stock ROMs will replace multiple ROMs at once. Whichever way you go, each ROM you install must be designed for your specific device to handle its specific hardware, otherwise, bits of your device (or the whole thing) will just stop working.

GOOGLE SYSTEM TOOLS

While there are numerous third-party tools for modding Android devices, two of the most important are

command-line utilities from Google called 'adb' (Android Debug Bridge) and 'fastboot'.

We introduced these utilities in our Android masterclass last month ('Hack your Android', page 100). They're tools included in the Android Software Development Kit (SDK) for app developers, but they're also extremely capable in their own right – and perfect for much Android hackery.

Third-party installers for these utilities have been available for some time, but in a stroke of good timing, Google recently decided to release ADB and Fastboot as a separate download from the SDK, meaning instead of several hundred megabytes of SDK you don't need, you can now download these tools for around 4MB from Google direct (tinyurl.com/jhy47m).

Added security features on some phones, such as Samsung's Knox, blow a software fuse if you ever flash a custom recovery ROM on your device, so there's no certainty you can truly return it to pristine 'as new' condition. Still, these Google tools, combined with your stock ROM, should provide your best chance of flashing devices back to stock. In fact, the method we'll show you is reported to work with Google's

Nexus/Pixel range, along with many HTC, Motorola, Oppo and Huawei phones. However, it won't work for all phones – in fact, Samsung Galaxy users should avoid this method (use Samsung's Odin tool instead). That said, here's how this method works:

STEP 0: BACKUP

Before you do anything to your phone, back it up. In most circumstances, flashing a system ROM is equivalent to a 'factory reset', erasing your personal files, so make sure you back up everything – apps are optional if you have access to them elsewhere, but personal files, including contacts and SMSes, need to be backed up 'off-phone' (not on the phone's internal or SD card storage). There are many methods for this – if you have root access, Titanium Backup on Google Play is a popular option.

STEP 1: INSTALL ADB/FASTBOOT

Make sure you download the Android SDK Platform Tools from tinyurl.com/jhy47m. There are zip files for Windows, Linux and MacOS X. It doesn't include the Google USB device driver, which you may need if you don't have it installed already.



If so, the 15-second ADB installer on XDA-Developers (tinyurl.com/jbg88re) is available as an alternative for Windows users that includes driver installation (the usual software security caveats apply).

STEP 2: DOWNLOAD THE ROM

This is the most important step — get this wrong and you could possibly kiss your device good-bye. As we said before, you must download the ROM designed for your specific device. Where do you find ROMs? We've collected a few brands (see box on the next page, bottom right), but for the latest ROMs from other brands, we'd start with XDA Developers (xda-developers.com) and hunt around. Just make sure the ROM is meant for your specific device — not just your model, but down to your phone network provider. We can't stress this enough. Once you've downloaded the ROM, unzip the IMG (.img) image file(s) to a known location — grab 7-Zip if you don't already have it (www.7-zip.org/download.html).

To use Fastboot, your ROM must exist as an IMG file. If it's a zipped folder, it's unlikely to work with this method.

SECURITY

The tricky part with downloading a ROM is that, unless it comes direct from your device manufacturer or a reputable community-based site, you can't really guarantee the ROM's

security and that it isn't loaded with malware. While we've not come across an infected ROM (yet), we can't discount that malwarmed ROMs exist.

The most practical way to check the quality of ROMs is to watch the forums for any signs of issues appearing with any ROM you intend to use. But ultimately, if security is a key concern for you, the safest thing is to not root and flash your device in the first place.

STEP 3: CONNECT UP

Next, plug your phone into your PC's USB port. If you haven't already, set your device into Developer mode. Launch 'Settings > About phone' and scroll down to the 'Build number' entry. Tap it seven times until you see 'you're now a developer'.

Back out to the Settings menu, tap the new 'Developer options' entry, tap the 'On' button and likewise for 'USB debugging'. This will allow your PC to initiate actions on your device via adb/fastboot. When you see the RSA key fingerprint message on your phone, tap 'OK'.

Next, open up a command prompt on your PC, type:

```
adb devices
```

...and press Enter. This will show if the Google USB driver has made its way onto your PC or not. If it has, you should see an Android serial code appear and 'device' to the right.

STEP 4: LAST CHANCE TO BACK UP

No joke, this really is the last chance to back up anything you've got stored on this device. The next step will perform an effective 'factory reset' and wipe all your personal data. If you have a microSD card on-board, rip it out and copy everything off first, just to be safe.

STEP 5: FLASH IT

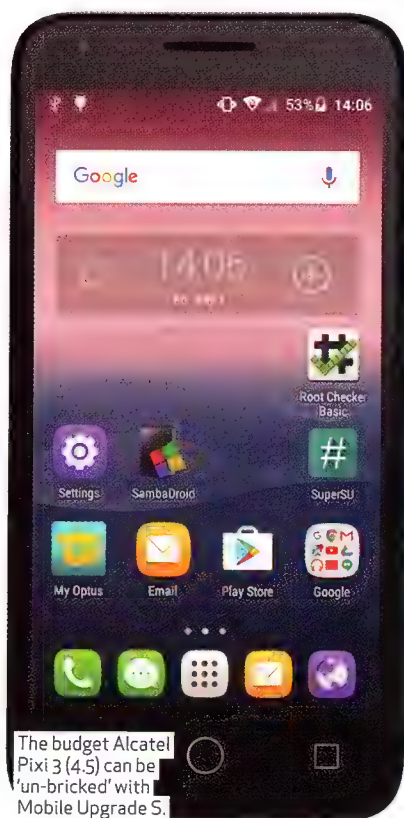
Now for the big moment. With the image file in the same folder as your fastboot and adb tools, you can now boot your device into fastboot mode with the adb command:

```
adb reboot-bootloader
```

After a second or two, 'fastboot mode' should take over. Now to flash the system image file, type in the following command:

```
fastboot flash system
<system_image_name>.img
```

"You can't just wing it and hope that a ROM that seems vaguely right will work."



ROM Downloads for you

www.htc.com/us/support.com/romdownloads.htm

HTC PRODUCTS ACCESSORIES VIVE SOFTWARE+APPS SUPPORT

Join Team HTC and Get Perks! CART (0)

HTC SUPPORT

ROM DOWNLOADS FOR YOUR HTC SMARTPHONE

Download the latest ROM for your carrier and device below. Please note: ROM Downloads are not available for Verizon Wireless Devices. However select Verizon Wireless devices can be updated using the HTC Sync Manager software. [Download HTC Sync Manager.](#)

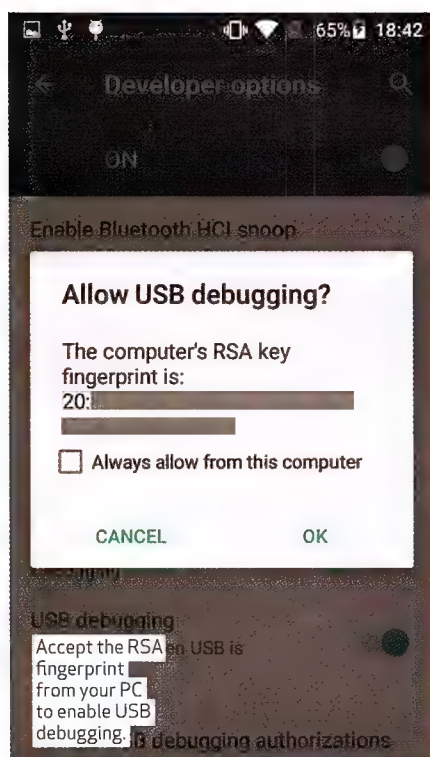
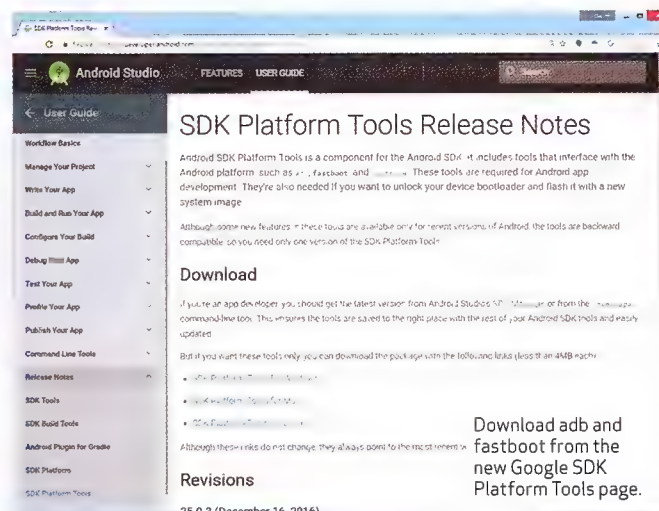
WARNING: If your Bootloader or device software has been modified, you may run the risk of damaging your device by installing the RUU.

[AT&T/Cricket](#) [Sprint/Boost/Virgin Mobile/C.Spire](#) [T-Mobile/MetroPCS](#)

[Unlocked/Developer](#) [Wal-Mart Family Mobile/Additional Devices](#) [Applications](#)

Device Name	Latest ROM #	Instructions	Link
HTC One A9	1.27.502.5	View	Download
HTC Desire 626s (Cricket)	1.23.506.6	View	Download
HTC Desire EYE	2.09.502.3	View	Download
HTC Desire 510 (Cricket)	1.11.506.8	View	Download
HTC Desire 512 (Cricket)	1.09.506.3	View	Download
HTC Desire 610 Postpaid	1.54.502.15	View	Download
HTC Desire 610 Prepaid	1.54.502.15	View	Download
HTC Desire 626	1.24.502.5	View	Download
HTC One M9	3.38.502.17	View	Download

HTC is one of the few phone makers to offer official ROM downloads.



Marshmallow and newer devices. **NOTE:** For security reasons, this wipes your device, but since you've already backed up, that won't matter. Once completed, try the previous 'fastboot flash system' command again.

STEP 6: REBOOT

With that done, the ROM should have installed and you're ready for your device to reboot. To do that, type on your PC's command prompt:

fastboot reboot

...and press Enter. Now for the nervous wait — the first boot after any reset always takes forever and, depending on the device, can be up to five minutes with the splash screen staring at you.

Worse is when you get the splash screen for a few seconds and the phone reboots, shows the splash screen again, reboots again and gets stuck in an interminable 'boot loop'. All things being as they should be, your device should eventually boot and ask you to select your language. If so, success.

WHAT IF IT FAILED?

We said it could fail, and even though it shouldn't fail, don't be surprised if it does. If the device won't boot normally, the ROM likely hasn't taken — and without a working ROM, you can't use this method. However, it's possible you may just need to wipe the Dalvik/ART cache — do this in your device's recovery mode and reboot.

Failing that, copy the ROM onto external storage (microSD), plug it in and reboot the device into recovery mode (power + volume-up buttons) and try using the recovery mode to flash the ROM instead.

Again, as every device is different, ensure you know how to use your device's recovery mode before you start.

...where `<system_image_name>` is the name of your system image file and press Enter. It'll take anywhere up to several minutes depending on the size of the ROM, at which point, your device should drop back to its fastboot prompt again.

If it fails, the bootloader may be locked. To check, run the fastboot command:

fastboot getvar unlocked

If it comes back with 'no', you'll need to unlock it and to do that, you run:

fastboot <code> unlock

...where `<code>` is replaced with 'oem' for Android 5.x/Lollipop or older devices, and 'flashing' for Android 6.x/

MIND THE GAP

Any time you flash a ROM to your smartphone, you're taking a calculated risk. That said, the flash process, these days, is as smooth as it's ever been, although we'd still triple-check everything before pressing the 'Go' button. The most important thing is ensuring the stock ROM you flash is designed for your device and that you've backed up everything before you flash. A combination of Nandroid backup via your recovery mode, Titanium Backup and your Google account should cover just about everything.

These Google SDK System Tools are extremely powerful and are more than capable of bricking your device if you don't show them the proper respect. But whether you use these tools or a dedicated app, there's no need to face a ROM that doesn't work for you.

Factory/Stock Image Options

Can't find a stock ROM? Here's a short list of official ROM options:

- Alcatel — www.alcatel-mobile.com/global-en/support/softwareUpgrade/list
- Google Nexus/Pixel — developers.google.com/android/images
- HTC — www.htc.com/us/support/rom-downloads.html
- OPPO — en.oppo.com/firmware
- Samsung* — www.sammobile.com/firmwares

* **NOTE:** Sammobile is not an official Samsung website. For details on flashing Samsung's Galaxy series back to stock, read our story on tinyurl.com/pt6tndy.

Make an Arduino-powered wireless message board

Darren Yates combines a compact LED-matrix board, Bluetooth module and Arduino Nano to create a wireless message board you load via your Android phone.

Scrolling message boards are cool and you see them just about everywhere. This month, we'll show you how to make your own. However, this one is a little different – you upload the message wirelessly via Bluetooth from your Android phone or tablet using a free app from Google Play.

MAX7219 4-IN-1 LED MATRIX

The key component of our message board is a MAX7219 4-in-1 8 x 8-LED matrix board. These are all over the web and come with four 8 x 8-pixel LED modules in a row, giving you a 32 x 8-pixel panel to play with. We've connected ours via SPI (serial peripheral interface) with three wires for the control signals to an Arduino Nano board. The other two wires provide DC power.

HC-06 BLUETOOTH MODULE

But to get text onto the message board, we've also added an HC-06 Bluetooth module. It runs at a low 9600bps data rate, but it's more than fast enough for our needs. It's designed to send and receive data over a serial connection, but to make installation less complicated, we've added the AltSoftSerial library, which adds a second serial port on Arduino Nano pins D8, D9 and D10. The HC-06 is powered by the Nano's 5V voltage rail;

however, its 'receive' (RX) input can only take 3.3V. So we include 10kohm and 20kohm resistors to form a voltage divider connecting the Nano's D9 I/O pin to the HC-06's RX input. The voltage divider drops the voltage from 5V down to 3.3V and, by placing the resistors as we have, we can just drop the HC-06 straight into the small 170-point breadboard.

BUILDING THE MESSAGE BOARD

These tiny breadboards are great for compact designs. To make things even more compact, we've fixed the breadboard to the back of the LED matrix board with double-sided foam tape. They're both about the same height and make a surprisingly neat little bundle. Follow the overlay wiring diagram and you shouldn't have too many problems. Just make sure to have the usual tools (needle-nose pliers, side cutters and so on).

FLASHING THE NANO

The last piece of the jigsaw from the Arduino side is our source code. Download it from apcmag.com/magstuff.

Unzip the file and copy the contents of the 'libraries' subfolder into the same of your Arduino IDE installation (we're using the excellent Adafruit_GFX, AltSoftSerial and Max72xxPanel libraries). Reboot the IDE (get it from arduino.cc), load up the

'WireMessBoard.ino' file, plug in your Arduino Nano board, select it from the 'Tools', 'Board' list, choose the COM port the Nano is connected to (not COM1 – that's your mouse) and press the green 'upload' button top-left to flash the code to the Nano. Plug the Nano board into the breadboard, power it up from a USB phone charger and it should fire up.

ANDROID APP

Once you've got the hardware up and running, it's time to try it out. We've designed this project to work with the ArduDroid app on Google Play (tinyurl.com/gr3lk6m) – it's free and works with any Android device with at least Android 2.3/Gingerbread and built-in Bluetooth.

The first step is to power up the message board, at which point, you should see the welcome message appear on the LED matrix as well as a flashing LED on the HC-06 Bluetooth module (the latter indicates it's waiting to pair with another Bluetooth device).

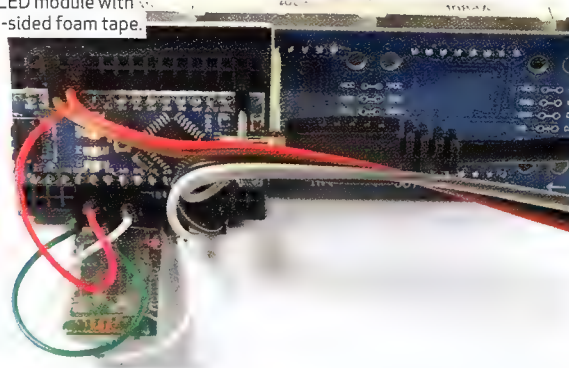
Next, install ArduDroid from Google Play. After that, go to the Android 'Settings' menu, select 'Bluetooth' under 'Wireless & networks', search for available devices and wait until you see 'HC-06' appear in the list (launch a new search if you have to).

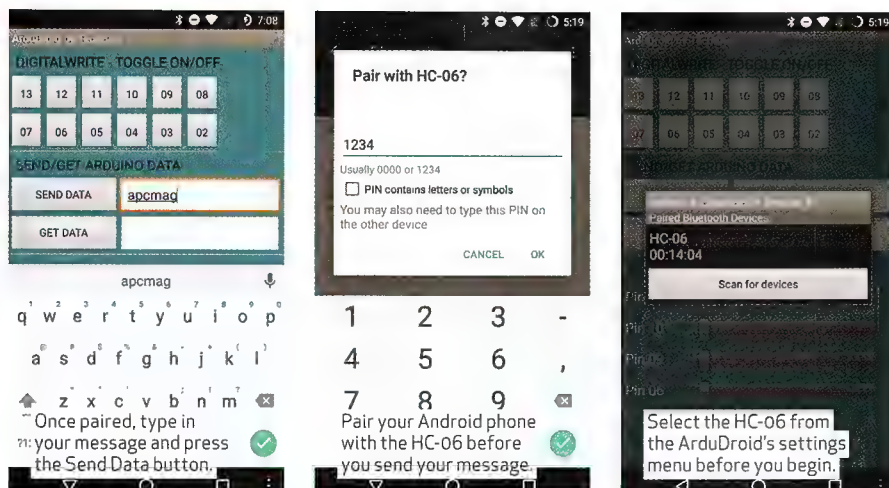
Tap on the entry when it appears, type in the four-digit pairing password

The MAX7219 LED matrix combines four 8 x 8 LED modules into one board.



The breadboard is fixed to the LED module with double-sided foam tape.

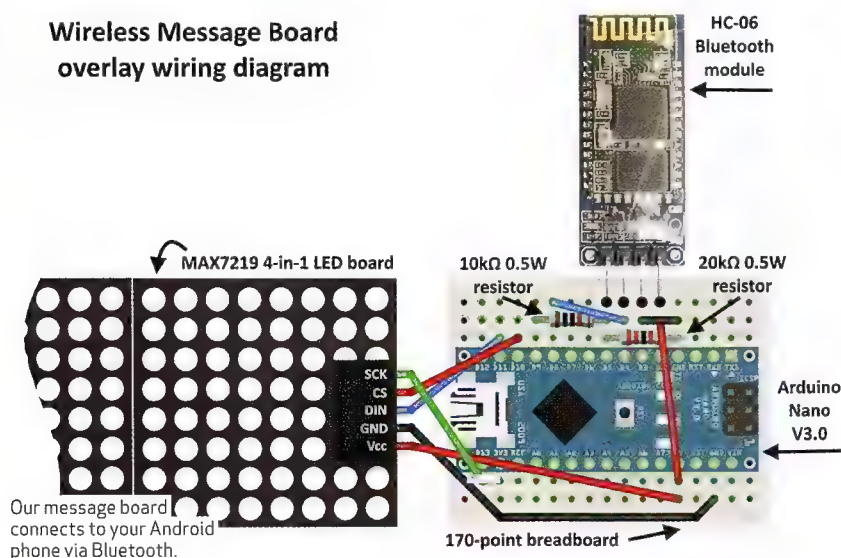




value into the `'matrix.setIntensity()'` command which sets the brightness. Be warned, though – running the matrix board flat-stick will chew up a lot of current, possibly more than your power source (and the Arduino Nano) can provide. You should find that a setting of '8' will be more than bright enough for most applications. Even the zero-level setting is easily seen in a well-lit room.

The scroll speed is primarily set via the `'scrollSpeed'` variable – the lower the value, the faster the scroll. The default is '40', which isn't too fast as to make you carsick, but you can speed it up or slow it down to suit your needs.

Wireless Message Board overlay wiring diagram



Our message board connects to your Android phone via Bluetooth.

(should be '1234') and tap OK. After a couple of seconds, the HC-06 should be listed under 'Paired devices'.

Next, launch ArduDroid, tap your device's menu button and select 'Connect me to a Bluetooth device'. You should now see the HC-06 listed – tap on the entry. Shortly after, ArduDroid should indicate that it is now connected.

Now for the moment of truth – in ArduDroid's 'Send/Get Arduino Data' screen panel, there's a text box next to the 'Send Data' button. Tap inside the text box and type a message. When you're done, press the 'Send Data' button. After the message board has completed its current message scroll-through, it should instantly update and begin displaying the message you sent. If so, congrats – it's working! Your new message will continue to loop until either you enter a new message or remove the power.

We're not sure of the maximum message length, but given the Arduino Nano's limited 2KB of RAM, you should get up towards 500 characters comfortably (we've tested to 100 characters – that seemed enough for

whatever we could think of saying at the time).

MODDING THE CODE

The two main source-code parameters you can adjust are the LED brightness and the message scroll speed. The brightness is set via the `'brightness'` variable, which must be a number from zero (dull) to 15 (sunnies). We feed this

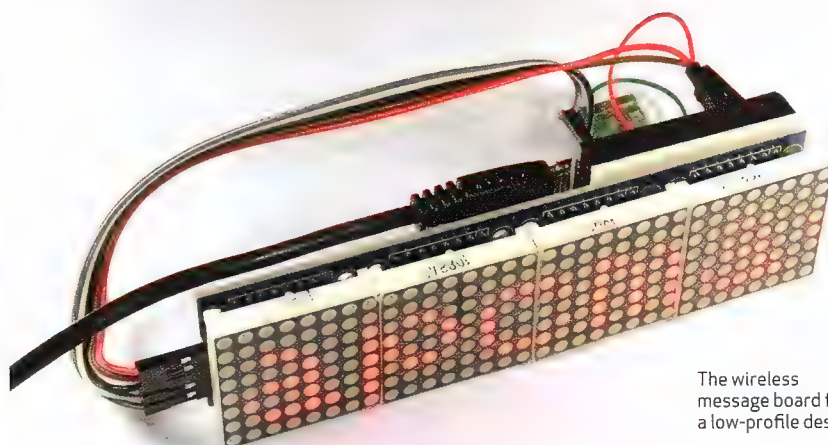
RANGE AND POWER

Bluetooth is a low-power wireless networking standard and the HC-06 is good for around 10 metres or so. This will vary depending on the radio-frequency and physical interference (line of sight) between you and the module.

In terms of power consumption, the whole thing draws approximately 100mA of current with zero-level brightness and the standard welcome message. That goes up to 200mA with a setting of '8'. If all LEDs are lit on an '8' setting, expect it to be around 600mA – but we don't recommend you use the 'all LED' setting for any length of time.

BUILD SOMETHING!

Arduino is a fun way to get your hands dirty and learn how to build your own computer-coded electronic gadgets. Even the tiny Arduino Nano microcontroller board is capable of much more than what we're using it for here. All it's waiting for is your imagination. ■



The wireless message board forms a low-profile design.

Python coding – Part 8: Making GUI apps

This month, Darren Yates begins a gentle look at how to create Graphics User Interface (GUI) apps in Windows using the Python programming language.

If you're interested in tech, learning to code is one of the best things you'll ever do, giving you skills that not only make you more employable, but also allow you to 'open the bonnet' and see how stuff works. So far in this series, we've covered the basics you need to create a range of Python apps, from variables to file operations and even classes. This month, we make the leap from command-line to GUI apps that will run on any Windows computer.

COMMAND-PROMPT VS GUI

All the apps we've written so far in this series run in the command-prompt window and despite what some may consider a boring façade, the command-prompt is a great way to start coding because the 'user interface' is taken care of for you. All you need are `print()` and `input()` functions and you're away.

But when you start writing GUI apps, you get to decide where everything goes – the buttons, the textboxes, radio buttons and more. It also means you now have two coding streams to consider – the app's functional code or 'algorithm' and the user interface design. Which do you code first – the app algorithm or the user interface? It depends, but if you're designing software professionally, you'd more likely start by consulting stakeholders – the people who'll have to use your software – to find out the features and functions they require, then build your

software around that, take it back to stakeholders for checking and so on. Still, rather than get bogged on the 'systems design and analysis' road, we'll just cover the nuts and bolts of creating Python GUI apps.

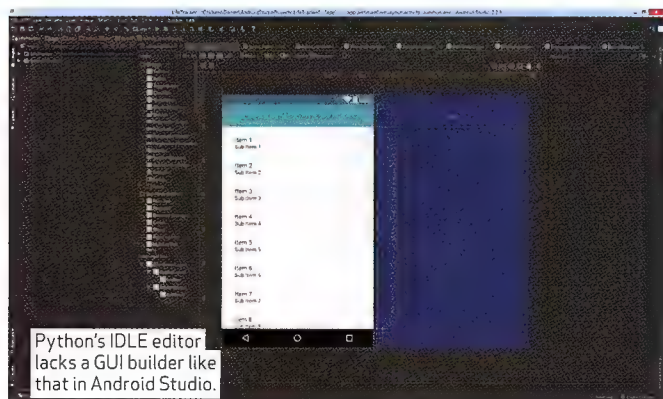
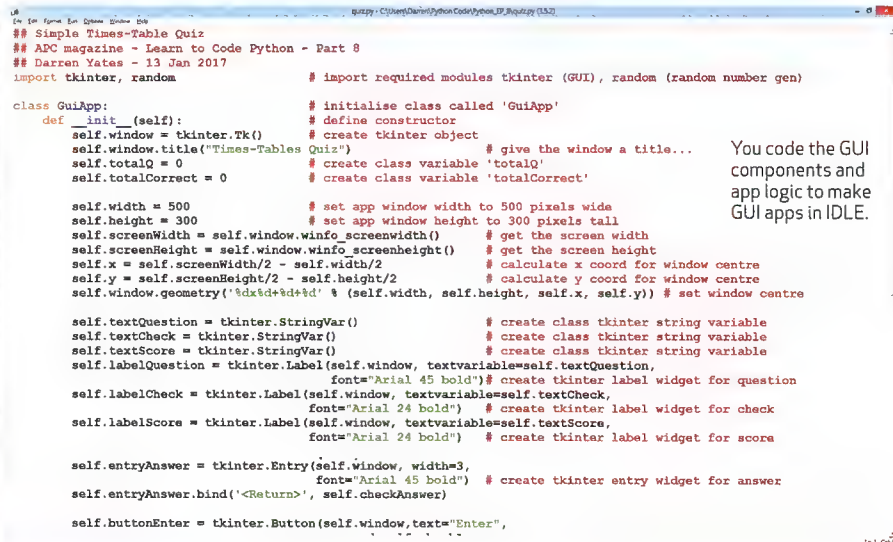
TRY-IT-AND-SEE

If you play around with Microsoft's Visual Studio or Google/JetBrains' Android Studio, you'll find these integrated development environments (IDEs) come with layout editors or 'GUI builders' that are a bit like desktop publishing for apps – you can drag and drop controls onto the app window as you want them to appear in the real

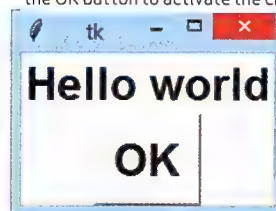
What you'll need

- Python 3.6.x — www.python.org/downloads
- APC Masterclass Python source code pack — apcmag.com/magstuff

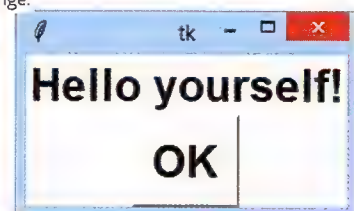
thing. However, Python's IDLE development environment doesn't have this, but that's not a bad thing when you first start – because you're forced to code manually and see what



The 'changeLabel' function is bound to the OK button to activate the change.



Before pressing the OK button



After pressing the OK button


```

import tkinter

class GuiApp:
    def __init__(self):
        self.window = tkinter.Tk()

        self.width = 300
        self.height = 200
        self.screenWidth = self.window.winfo_screenwidth()
        self.screenHeight = self.window.winfo_screenheight()
        x = self.screenWidth/2 - self.width/2
        y = self.screenHeight/2 - self.height/2
        self.window.geometry('%dx%d+%d+%d' % (self.width, self.height, x, y))

        self.labelText = tkinter.StringVar()
        self.labelText.set("Enter your name:")
        self.label = tkinter.Label(self.window, textvariable=self.labelText,
                                   font="Arial 24 bold")
        self.label.pack()

        self.entryName = tkinter.Entry(self.window, font="Arial 24 bold")
        self.entryName.pack()

        self.buttonOK = tkinter.Button(self.window, text="OK", font="Arial 24 bold",
                                       command=self.changeLabel)
        self.buttonOK.pack()
        tkinter.mainloop()

    def changeLabel(self):
        self.labelText.set("Hello "+self.entryName.get()+"!")

my_gui_app = GuiApp()

```

Creating your GUI as a class makes it easier to create multiple copies.

```

import tkinter

class GuiApp:
    def __init__(self):
        self.window = tkinter.Tk() # create window widget

        self.labelText = tkinter.StringVar() # create label string
        self.labelText.set("Hello world") # set string to 'Hello world'
        self.label = tkinter.Label(self.window, textvariable=self.labelText,
                                   font="Arial 24 bold") # create tkinter lbase
        self.label.pack() # pack the label

        self.buttonOK = tkinter.Button(self.window, text="OK", font="Arial 24 bold",
                                       command=self.changeLabel) # create button
        self.buttonOK.pack() # pack the button
        tkinter.mainloop() # launch the tkinter mainloop

    def changeLabel(self):
        self.labelText.set("Hello yourself!") # create 'changeLabel' function
        # change label text

my_gui_app = GuiApp() # create class instance (Go app!!!)

```

The 'helloworld.py' adds a label and button to a window widget.

"You now have two coding streams to consider — the app's functional code or 'algorithm' and the user interface design."

works. This way, you get to understand what the GUI code actually does. Sure, once you're more familiar with things, move onto other more feature-rich IDEs (as most people do). But to begin with, the more you understand how your code works, the easier you'll find coding in the future.

CREATING A WINDOW

Python, on its own, doesn't know anything about GUI apps, but the power of Python is in its modules or 'libraries' that enable you to bolt into your code almost any functionality you can think of. GUI apps are no exception to this and there are at least a dozen different libraries you can add that handle GUI development alone. However, since the IDLE environment itself is written in Python, it comes with a GUI library bundled called 'tkinter'. It's actually a programming language of its own called 'tcl' with an extension called 'tk' for creating GUI controls or 'widgets'. Combined, they're known as 'tcl/tk' and come preinstalled in many Linux/Unix distros, including Mac OS X (although, you need to be careful here — tinyurl.com/lvrb835).

To create a simple 'hello world' Python GUI app, we need to import tkinter (short for 'tk interface') into our app and in IDLE on Windows, we do that with:

```
import tkinter
```

Last month, we introduced the concept of 'object-oriented programming' (OOP) and 'classes',

so let's use one here:

```

import tkinter

class GuiApp:
    def __init__(self):
        self.window =
tkinter.Tk()

        self.window.
geometry('400x300')
        tkinter.mainloop()

my_gui_app = GuiApp()

```

The class, called 'GuiApp', defines what the interface will look like, which here, is just a blank window. We define it inside the initialisation (" __init__ ") or 'constructor' function and fire up tkinter's mainloop() function to display it. After that, we create a copy or 'instance' of the GuiApp class and call it 'my_gui_app', which automatically creates the window and displays it. The size of the window in pixels is set by the geometry() function and the character array parameter '400x300'.

TEXT LABELS

An empty window isn't particularly useful, so open up 'helloworld.py' in the IDLE editor from this month's source code pack and we'll start adding widgets, two of the most common being labels and buttons. Labels let you add text to a window, buttons add user-control commands for further actions. To add a label, you use tkinter's 'Label' function — it has a number of parameters, most of which are optional, except the first,



which identifies where the label belongs.

Labels, like other tk widgets, have to belong somewhere, they have to have a 'parent' widget. Here, we assign the label to self.window, which is the root tk widget for this class. You also must specify the text you want the label to display. You have two options for this — you can use a fixed string or 'literal', such as "hello world", or you can assign a variable.

Remember us saying previously that tkinter uses the tcl language? To pass text to the label, we need to create an instance of a tk variable class called 'StringVar' (String Variable):

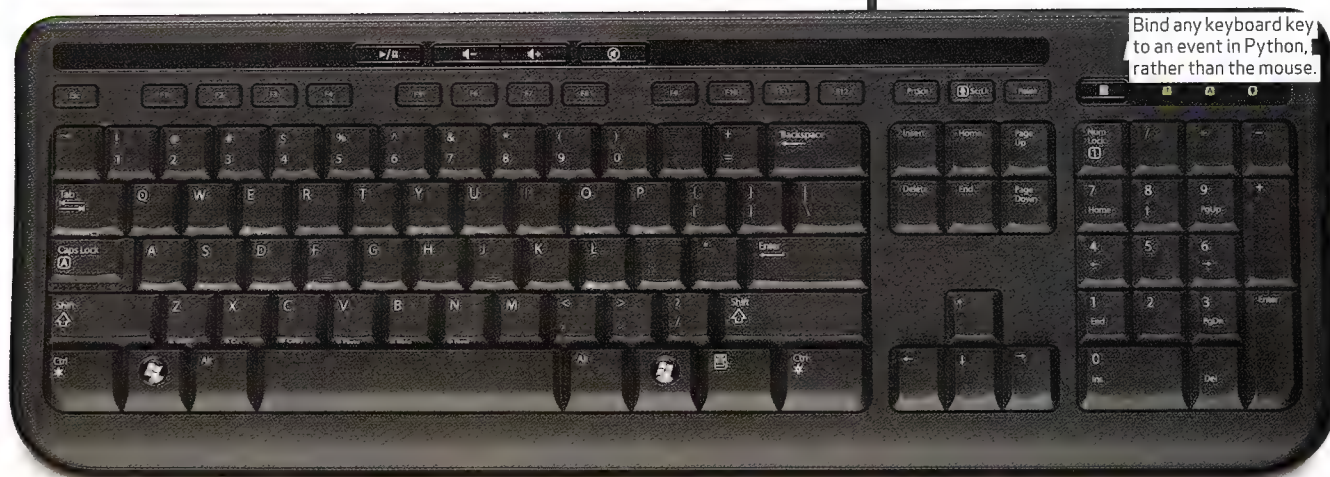
```

self.labelText = tkinter.
StringVar()
self.labelText.set("Hello
world")

self.label = tkinter.
Label(self.window,
textvariable=self.labelText,
font="Arial 24 bold")
self.label.pack()

```

We then assign text to the variable using StringVar's set() function. Lastly, we call the pack() function to add the



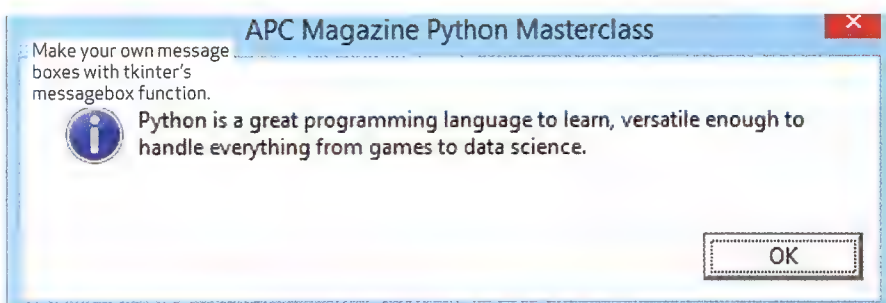
label to the window, which invokes the layout manager. Tkinter has three main layout managers – pack, grid and place.

'Pack' brings in the various widgets you code and automatically places them within the window, using only the space needed. However, the alignment may change depending on how the user changes with window size. 'Grid' uses a table-like arrangement, aligning widgets into rows and columns. It's simple enough, but fairly rigid. 'Place', on the other hand, lets you decide exactly where a widget sits in the window, down to the pixel. It sounds great, but if users can resize your app window, those fixed-position widgets won't neatly realign of their own accord. So while it's versatile, 'place' requires more work to always look right (unless you lock your app window size).

COMMAND BUTTONS

Command buttons are the most common app control and adding a button is similar to adding a Label. In our 'helloworld.py' example, we create an instance of tkinter's Button object and assign it to a new object 'self.buttonOK'. The first parameter is, again, the parent widget, followed by the text you want the button to show. After that, you indicate the function you want launched when the button is pressed (in this case, it's a function we create called 'changeLabel'). Again, we 'pack' the buttonOK object into the self.window widget and finally, run the main tkinter loop.

We haven't created the 'changeLabel' function yet, so let's do it now. We start by defining it as a separate class-member function using the 'def' keyword and here, just to keep things simple, we'll get it to just change the above label text to read: 'Hello yourself!' So the link between the command button and the function



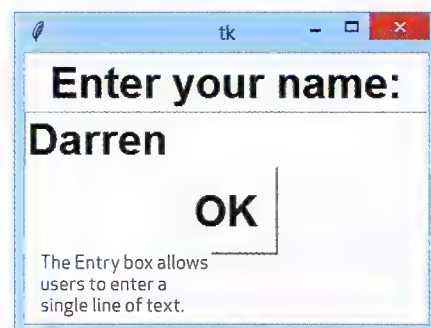
is the 'command' parameter in the Button() function initialisation (remember the 'self' prefix).

TEXT ENTRY

The other common widget is the Entry widget, which provides the user a single-line text entry area. Open up 'entername.py' and you'll see the only mandatory parameter is, again, the parent widget. Now to get hold of the text the user enters, use the get() function, which returns the text as a string object – in this example, we're changing the label text by incorporating the contents of this string object as a personal greeting.

CENTRING THE APP WINDOW

One thing you might want to adjust straight away is the location of your app on the computer screen. At the moment, our apps are all located near the top-left corner, by default. Python and tkinter don't have a function to auto-centre app windows, but you can code your own using built-in parameters. First, decide on the app window frame size you want by choosing a 'width' and 'height', in pixels. Next, get tkinter to return the current screen width and height, again, both in pixels, using the functions wininfo_screenwidth() and wininfo_screenheight(). Now, halve the screen width and subtract half the app window width, then halve the screen height and subtract half the app



window height and you'll have the top-left corner coordinates that guarantee your app will appear front-and-centre.

KNOW YOUR TIMES TABLES

OK. We've now got some basics under our belt – we can create a window with a label, command button and user text-entry widget. Now let's use some of the other Python knowledge we've gathered over the last few issues and create a GUI app. Nothing too complicated, just something to get started. And remember, this is just one way to do it – there's always more than one way to code an app.

Our new 'quiz.py' app is a basic times-table quiz that asks you to answer random times-table questions and keeps track of the number of questions you get right, along with the total number asked. It builds on what we've just learned, but also adds

in some extra tweaks. For example, adding a title to the app window. You add it to your tk() object using the title() function — just give it a string of text and that's it.

The app also has three labels — labelQuestion, labelCheck and labelScore. Note also the new font parameter — you can change the font type and size with the 'font' string, starting with the font name, its point-size and any font additions (bold, italics and so on).

PACKING ORDER MATTERS

One other thing to remember — the order in which you enter the 'pack()' statements into your code is the order they'll appear in your app. You can put these statements wherever you want (within reason), but the order matters. The same also occurs for 'grid()'. However, since 'place()' allows you to set the exact positioning, widget order doesn't matter in that instance.

CLASS FUNCTIONS

At the start of this masterclass, we mentioned that GUI apps require you to consider two streams — the GUI design code and your app functionality. The quiz app functionality here mostly takes place in the two class functions, checkAnswer() and newQuestion().

The app begins by running newQuestion() to generate a new times-table question. This consists of generating two random integers between zero and 12 and assigning them each to a variable, 'arg1' or 'arg2'. We then use these to update the textQuestion variable, which appears

in the labelQuestion label. We also delete any text inside the entryAnswer user-entry textbox.

When the user enters an answer and clicks on the OK button, it fires up the checkAnswer() function, which checks whether or not the answer is correct. If it is, it notifies the user and adds one to the 'totalCorrect' variable. If it's not, it notifies the user the answer is wrong.

Now note the source code indentation here — as we've mentioned many times previously, code indentation is of primary importance in Python. The last three statements of the checkAnswer() function are in the same indent alignment as the if-else statement, meaning these statements are separate to the if-else statement.

In these last three statements, we add one to the 'totalQ' tally, update the score and launch the newQuestion() function again to come up with the next question. As a result, the app cycles around this loop until the user gets bored and shuts down the app.

BINDING KEY EVENTS

Pressing the OK button with the mouse every time is a bit of a pain. What about being able to also use the enter/return key? You can do that by attaching or 'binding' this event of pressing the enter key to the entry widget. A couple of things, though.

First, tkinter calls the enter key 'Return' rather than 'Enter'. The function we want to launch when the enter key is pressed is checkAnswer(), as before, but you must also include the 'event' parameter in the checkAnswer

function's parameter list, otherwise, logic error.

EVENT-DRIVEN PROGRAMMING

If you've been following this series, you might have seen a bit of a difference in the way the apps this month have been coded compared with previous episodes. GUI-based apps are all about events — a user pressing a button or a key, checking a box or entering text. This 'event-driven programming' concept parallels object-oriented programming.

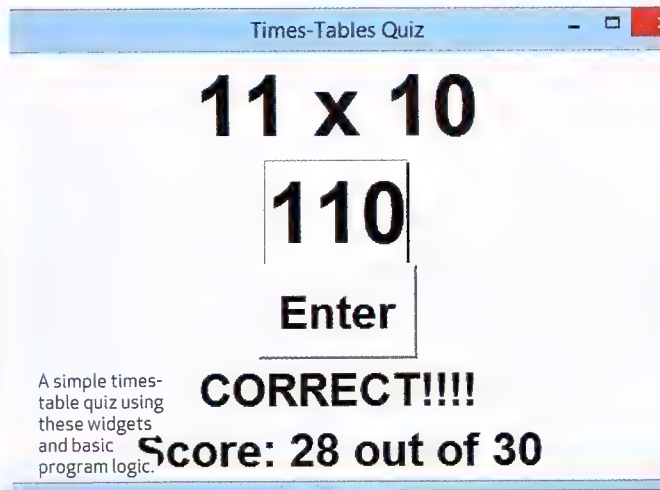
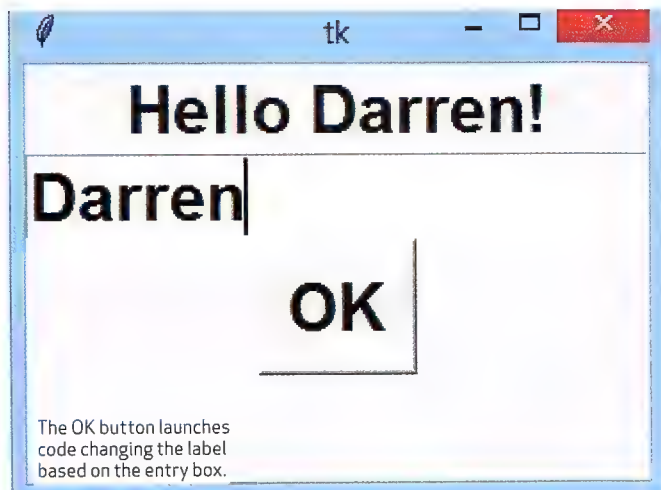
Here, you're not directing the user to perform a task by following a specific code path. Instead, you allow the user to 'drive the bus' and your code simply responds to actions they select. Think about the way you use your phone, PC or notebook — your productivity apps, for example, let you choose when you want to change a font or save a file or whatever. Using an event-driven programming paradigm is how that's achieved.

As you can imagine, we've barely scratched the surface of what Python GUI programming is all about. See you again next time. ■

```
self.labelQuestion.pack()
self.entryAnswer.pack()
self.buttonEnter.pack()
self.labelCheck.pack()
self.labelScore.pack()
```

```
# pack the question label first.
# next the user entry widget...
# followed by the 'enter' button...
# then the check label...
# and finally, the current score label
```

When packing widgets into a window, the pack order matters.



downtime

» GAMES: EDITED BY CARMEL SEALEY

In *RE7*, you meet this family, who offer a beautiful feast of... is it kangaroo meat?

✓✓✓
apc
RECOMMENDS

PS4, X0, PC | \$99.95 | RESIDENTEVIL7.COM

Resident Evil 7: Biohazard

The famed series returns to brutal and bloody survival horror.

About four years ago, the survival horror genre was pretty much dead, and no one expected it to come back. It was the era of big-budget war shooters — all catharsis and beefed-up military bros. Perhaps the industry thought we no longer had the patience: even the last two *Resident Evil* games were basically third-person shooters.

Now, after the genre's unlikely resurgence thanks to *Alien: Isolation*, *Outlast*, the *Amnesia* series and *PT*,

Capcom feels comfortable enough to take *Resident Evil 7* back to its roots — and with a first-person perspective as well. Call it cynical, but when the outcome is as good as this, I suppose it doesn't matter. *RE7* doesn't stand out among the resurgence pack, but it marries tradition with modern design, meaning its heritage comes as a huge advantage.

The protagonist is some guy who's received a video message from his girlfriend, which warns him to stay away from the creepy

mansion in which she's been imprisoned for three years. Naturally enough, he goes anyway. Any more details and we're entering spoiler territory, but just know this one thing: *Resident Evil 7* isn't a subtle horror game. In fact, it's probably among the most grotesque on the market. Proceed as you will based on that information, but I found it quite refreshing, that a horror game would avoid the in-vogue psychological tack and go full-innards-on-the-screen gross-out.

That said, despite a thick and ugly mood, it will undoubtedly come across predictable to anyone well-studied in the genre, though the encounters are harder to anticipate the longer you play. The move to first-person is wise because it creates a sense of claustrophobia, while making the shooting a little less cumbersome. Still, don't come in expecting to mow down enemies à la *DOOM*:

you play as a regular nobody, and ammunition is as scant as your shooting skills are bad.

The usual cycle of puzzle-solving and monstrosity-evading is in tact here. If you're the type unwilling to die and respawn more than a couple of times, either stay away from horror games or, at least, play on easy mode. The environment, while quite small by modern video game standards, is labyrinthine and strange, and you'd be well advised to pay close attention to the paintings on the walls.

Resident Evil 7 is a huge return to form for the series, and while it doesn't bend any conventions like *Alien Isolation*, a good survival horror game doesn't really need to. ■ Shaun Prescott

Verdict

Not a groundbreaking approach to horror, but it's the horrifying kick to the gangrenous butt this series needed.

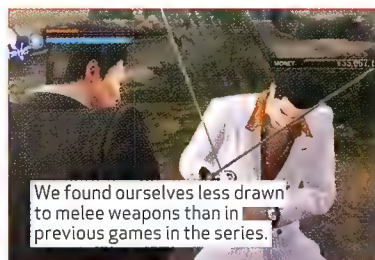


Given Sydney's property crisis, I'd rent here in a jiffy.

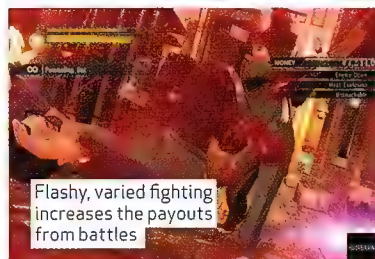


Majima's 'Breaker' style is a thrillingly ludicrous way to fight. You can devastate groups of enemies in a tornado of whirling limbs.

apc
RECOMMENDS



We found ourselves less drawn to melee weapons than in previous games in the series.



Flashy, varied fighting increases the payouts from battles



Yeah, it's the '80s.

PS3, PS4 | \$79.95 | YAKUZA.SEGA.COM/YAKUZA0

Yakuza 0

It's the '80s and this is where all the trouble begins.

As a CRT screen fades to black after a minute-long, live-action video of a bikini-clad model simpering on a bed, we hear a relieved sigh from Kiryu, and the camera pans away from the TV, lingering on the box of tissues next to it. The Yakuza series has long had woman trouble, with its damsels and sex objects, but never has it been so overtly mucky.

At the underground club Vincent, you can bet on fights between girls whose proportions and state of undress would make even Team Ninja blush. Over in Osaka, Goro Majima can recruit girls off the street, dressing and making them over as he sees fit before putting them to work in his cabaret club.

Perhaps there's a narrative justification for all this. *Yakuza 0* is, as its name implies, a prequel; Kiryu is barely 20, Majima just four years his senior.

No doubt the fires in their loins burned a little brighter back in the late '80s, and thwacking a near-endless stream of bad guys wasn't quite enough to work through all that surplus testosterone.

Side activities have been brought to the fore a little. You'll turn a corner on your way to your next objective and be stopped by a person in need of help, rather than needing to seek them out. When, as Kiryu, we're told by a group of homeless men that they'll only give us the information we need if we buy them a specific round of drinks — each wanting something different, requiring trips to several shops — our journey sees us strike up a friendship with a shop assistant, help a boy who's just been mugged, fill in as a producer on a TV shoot in a restaurant, then stop off for an arcade-perfect game of *OutRun* on the way back. As Majima, we're told we have two days

to carry out a hit or we'll become the target. Minutes later, we're infiltrating a cult to rescue the daughter of a nice lady we just met.

You can always say no, but you never will — and it's not just because you're playing as Kiryu, one of the nicest men in videogames. Now, reaching certain progression milestones awards you Completion Points, which can be exchanged at a city shrine for buffs, moves, items and abilities.

The combat system has had a massive overhaul. *Yakuza 0*'s dual-protagonist setup may seem, on paper, like a backwards step, given the series' recent habit of offering you multiple playable characters, each with a different fighting style. The solution is to give Kiryu and Majima three styles each, switchable in realtime. That gives the game an unprecedented level of flexibility, and means combat is often as

much about finding the right tool for the job as it is about mashing buttons.

That late-'80s setting is put to brilliant use in the story with a good old-fashioned gangland power struggle. Every face you meet is new, a blank slate even if you recognise them from other games. This is a reboot in the truest sense.

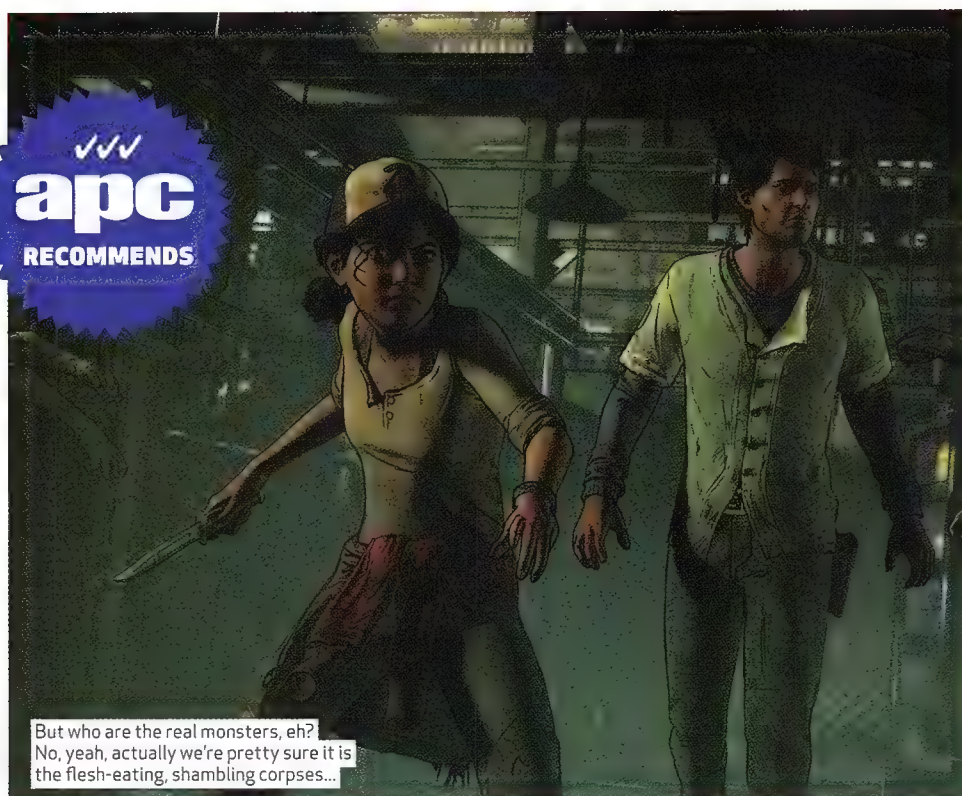
Recent Yakuza games have begun with the option to recap the story so far in lengthy, newcomer-baffling cinematics. Well, no longer. With *Yakuza Kiwami*, a hitherto Japan-only remake of Kiryu's first PS2 outing, finally coming to the West this year, there's never been a better time to jump into this series. ■

Verdict

This is a fun prequel that both newcomers and old dogs will enjoy equally.



✓✓✓
apc
RECOMMENDS



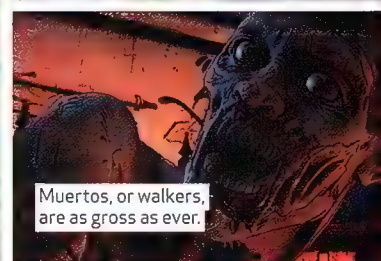
But who are the real monsters, eh?
No, yeah, actually we're pretty sure it is
the flesh-eating, shambling corpses...



Javier's familial tensions
are a great source of drama.



The only constant in this
ever-surprising world is
Clementine.



Muertos, or walkers,
are as gross as ever.

PS4, X0, PC, MOBILE | PC, US\$29.99; PS4 & X0, \$49.95; MOBILE, \$7.99 (PER CHAPTER) | WWW.TELLTALE.COM

The Walking Dead: A New Frontier

We grit our teeth and get stuck into the traumatic first two episodes of the new season.

As disgraced baseball star Javier García, the rapidly spreading viral outbreak forces you to shift priorities fast and shoulder new burdens just as quickly, making you responsible for two young lives. With our setting transferred to Virginia and a cast of new, original characters, *A New Frontier* is a fresh start, a jumping-on point for those who've yet to experience Telltale's carousel of emotional pain.

Clementine, the hardy teenage heroine, who we first met as a vulnerable eight-year-old, is the subject of an opening questionnaire, allowing you to skip loading in your season two save file and start afresh. You can also pick Clem's friends. Choose Kenny and he'll be treated like a saint, but opt for Jane and Kenny will be entirely absent.

Clem's fate is intertwined with that of Javier. His story begins with the death of his

father and a scrap with his overbearing brother, David, who's furious that Javier's late to the deathbed. The world is blissfully unaware of 'walkers' at this point, so when David's daughter Mariana wonders aloud why her grandpa is suddenly standing up, the family is intrigued rather than horrified. That's until he starts biting. It's one of many ways *A New Frontier* invites newcomers, by launching at the dawn of the comics' chaos to show how a different set of people, with their own lives, values and perspectives, react to a shared catastrophe.

Flash forward four years and Javier's predicament has grown complicated. He's in a car with Mariana, his nephew Gabe, and David's wife, Kate. The battered station wagon turned moving fortress is their only defence against a thousand-strong herd of walkers marching relentlessly their way. Every group of

survivors has a plan — for Javi's clan it is simply to keep rolling. But that will be stressful in a car with busted AC and a stereo that ate Gabe's last cassette.

That title of 'parent' is one Javier takes on reluctantly. This tension is there throughout the two episodes, balancing the protection of the youngsters against the preservation of your identity. Mariana stays on the right side of charming, using earphones to avoid confrontation despite her tape player being out of batteries. Gabe, on the other hand, is a petulant brat. Later, in a junkyard, Javier finds a hut with beds, weapons, and chocolate pudding, and Gabe begs his uncle to pitch up there. Do so and you'll score points with him but put everyone in danger. Don't and he throws a strop. It's a classic dilemma, a choice between keeping your family happy or safe. This game is about choices. Even if those choices are

illusory in retrospect, they feel real enough at the time.

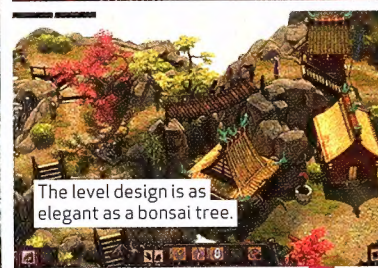
The pacing is consistent with previous seasons. Typically there's a lull while you poke around a hub of life, then havoc erupts and you use QTEs to dodge, shoot and stab. What has changed is Telltale's proficiency. This is a finely honed model, with carefully judged proportions of tender moments, scintillating set-pieces, tough choices and painful cliffhangers. Sticking to a tried-and-tested format, *A New Frontier* takes two successful steps into the series' new season, rewarding those who've been there from the start but not requiring you to have been.

■ Ben Griffin

Verdict

While it lacks the punch of Series One, it's a step forward after Series Two, and Javier is a great anchor.





PC (PS4, X0 COMING SOON) | US\$39.99 | WWW.SHADOW-TACTICS.COM

Shadow Tactics: Blades of the Shogun

Secretly last year's best stealth game.

Two soldiers patrol a stretch of road. They see nobody. Then a sound that can only be described as "adorable" inspires one of them to wander off. The source is an improbably cute tanuki, or raccoon dog. Entranced, the soldier doesn't notice the rock hurtling from above. As it turns him into a smooth paste, there's the flash and bang of a matchlock pistol, and soldier number two goes down. I exhale. Two more foes fall to *Shadow Tactics'* heroes.

This tale of an unlikely cadre attempting to stop a civil war consists of 13 elaborate and complex stealth missions where the odds are seemingly stacked against you. Thankfully, the quintet, made up of a sake-loving samurai, three ninjas and an old man with a gun-leg and pet raccoon dog, have all the tools they need. Each has skills to distract and kill, along with more specialised

tricks ranging from geisha disguises to explosives.

Every enemy encounter is one piece of a huge clockwork puzzle, orderly and repetitive, and the key to its solution is to disrupt the pattern. The fun part is creating chaos with the toybox of abilities. There's a lot of fun to be had playing with different strategies and stitching together the best parts until you have something that works.

Sometimes a problem requires lateral thinking. Snow can make a well-planned attack fall apart when a foe spots footprints, for instance, but a snooping guard will also helpfully follow such footprints to their end, where a trap can be prepared.

A lot of obstacles can only be overcome through teamwork, and that's where the handy Shadow Mode comes in. It's used to set up more complex assaults, assigning each character a job and activating them all at

once. That way, a large group of enemies can be swept away in one swift move. It's a thrill to just hit a button, sit back and watch my minions take out a room full of enemies in tandem.

Each mission introduces unique objectives and new game mechanics, and even the number of characters under your control changes. This rather effectively stops you from getting too comfortable with one tactic. You're tasked with prison breaks, assassinations, burglaries and even stopping armies, in a whirlwind tour of Japan. These missions are designed to be replayed, as they're essentially sandboxes fat with possible solutions. Unlockable challenges such as speed runs provide additional incentive. Just as much diversity can be found in the themes and striking art direction.

The story has been given an unexpected degree of attention, too. It's a mostly

simple, but well-spun, yarn that manages to explore its heroes and give them meaningful arcs absent of overbearing exposition or lengthy cutscenes. It's through the mid-mission banter that we learn the most about the band and see them grow.

Blades of the Shogun might evoke the stealth escapades of decades past, but it's an exceptional addition to the genre in its own right. It's tricky, complex without being complicated, and full of enough character and user-friendliness that even the stealth-averse might find something to tempt them into the shadows. Did I mention you get a tanuki?

■ Fraser Brown

Verdict

Impressive missions, a laden toy box and a likeable cast make this one of the great stealth games.





LG's super-duper 5K display is a sensitive poppet

Has a hissy if placed it too close to your router.

While some of us are still mourning the discontinuation of the Thunderbolt Display, the alternative recommended by Apple — the 27-inch Retina LG UltraFine 5K Display — at first appears to be a fairly good one, despite its non-Apple design. However, get it within two metres of a router and it has a habit of not working. According to LG tech support, routers can cause performance issues with this particular monitor, making us wonder whether this is actually the best alternative to the Thunderbolt Display after all, as many users would likely be using one in close proximity to their router.



Austrian hotel guests locked out of rooms by ransomware

RED...RUM!

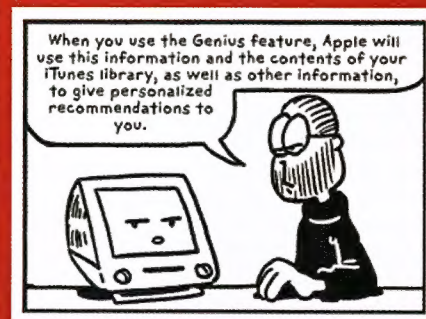
While hotel key cards are both convenient (you can slip it into your wallet) and better for security (can be cancelled or recoded after a guest checks out), we'd be surprised to hear if you told us you'd never had a problem with getting your door to open with one. Well, a whole hotel recently had issues when cybercriminals hacked the Romantik Seehotel Jägerwirt computer system and locked all the doors to the guest rooms. Luckily for the resort, the hackers were less interested in stealing credit card and personal details of the guests, but simply demanded approximately AU\$2,100 in exchange for unlocking the system. After a second hack was attempted, the managing director said they would be returning to "old-fashioned door locks with real keys. Just like 111 years ago..."



Apple II gets its own port of Portal

THESE POINTS OF DATA MAKE A BEAUTIFUL LINE.

There are few games as worthy of preservation as Valve's 2007 classic *Portal*, in which you solve physics and logic puzzles in order to escape a science lab run by a rather mean AI. However, when you think of porting a game to another platform, the Apple II computer is probably not the first one that comes to mind. Vince Weaver, assistant professor of computer engineering at the University of Maine, was inspired by the game's ASCII-art credit sequence and set about recreating the credits, then "one thing led to another". One week later, he had an abridged port of the game working on his 1987 Apple IIe. To check out his project, head here: www.deater.net/weave/vmwprod/portal



Kapow!

ITUNES TERMS & CONDITIONS NOW WORTH READING (IN COMIC FORM).

Nobody reads the terms and conditions for iTunes (or anything else), due to the fact that it's boring and hard to read. So R Sikorayak decided to use his talent for drawing cartoons to create *iTunes Terms & Conditions: The Graphic Novel* mimicking the art styles of well known comic strips, such as *Garfield*, *Peanuts*, *Calvin & Hobbes*, *Archie*, *Frank Miller's Batman*, *Dilbert*, *Tintin*, *Adventure Time* and *Watchmen*. True, it's still hard to understand but the different depictions of Steve Jobs in his turtleneck are amusing. Check out the unabridged work here: itunestandc.tumblr.com/tagged/comics/chrono ■

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- Built-in object-oriented firewall
- IPv6 & IPv4
- 1 x USB port for 3G/4G modem, file sharing and network printer
- IEEE 802.11ac WLAN for Vigor2925ac
- VoIP (V model)



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